THURSDAY, NOVEMBER 13, 1919.

THE TURKS OF CENTRAL ASIA.

The Turks of Central Asia in History and at the Present Day: An Ethnological Inquiry into the Pan-Turanian Problem, and Bibliographical Material relating to the Early Turks and the Present Turks of Central Asia. By M. A. Czaplicka. Pp. 242. (Oxford: At the Clarendon Press, 1918.) Price 15*s.* net.

THIS small and closely packed book deals with a big and intricate subject which can be dealt with satisfactorily only on a much larger scale, and it is to be hoped that its talented and learned author will presently give us a larger monograph in which the earlier history of the Turks, with its dramatic ties with the fortunes of Asia and Europe, will be told in much greater detail. It is opportune that such a book should appear when the greatest and most powerful empire established by the Turkish race is passing away, and when the thoughts of many of us are turning with a good deal of interest to the period in its history when the race emerged from the prehistoric age and began its wider sphere of interest. It is not possible in the space which NATURE can spare to do more than give a bare outline of the subject.

The Nomadic peoples who occupy the great stretch of grassy steppes, barren lands, and stony plateaus of Asia from the River Ural to the Yellow Sea form a group which is closely united by physical ties and by language. Their speech, although mutually unintelligible, has a common grammatical structure and a large number of common words. They are divisible into two main branches, respectively known to the Chinese as the Eastern and Western barbarians. Each of these divisions is again separable into two sections, one of them including the Mongols properly so-called, and the Tungus, better known in the West from one of their tribes as Manchus, and occupying the eastern part of Central Asia, of which the great desert of Gobi and its borders form the kernel. The other section, comprising the Turks and Finns (each divided into various tribes), occupies the country west of Mongolia, and is grouped about the great mountain chains of the Urals and the Altai Mountains, and is often spoken of as the Uralo-Altaic section of the human family.

At the time when history first notices this group, they were probably nearly as much separated as they are now, the great distinguishing feature which separates these two branches being that, while the Finnish branch were at that time almost entirely hunters and fishermen, the Turks have always been nomad herdsmen, having been occupied chiefly with the rearing of cattle, horses, and camels.

In their early days one section of the Turks formed the "frontagers" of the Aryan peoples, who lived in the Persian provinces of Khorasan, Balkh, and Transoxisia, which they continually worried and attacked. The two lands, that of the nomads and that of the settled people, were respectively known to the Persian writers as Turan and Iran. This Western section is generally known as the Western Turks, and was perhaps the only portion of the stock specifically called Turks at that time.

Another great section occupied the frontiers of China and the greater part of what is now known as Mongolia, and in the earliest Chinese writers are known as *Hiong Nu*, or *Hiun Nu*. The Hiong Nu formed a very powerful empire, which fought on equal terms with China, and was a serious menace to the latter empire during the Chinese dynasties of the earlier and later Han. The power of the Hiong Nu was gradually sapped in their struggles with the Chinese, and they were eventually attacked and conquered by their Eastern neighbours, known to the Chinese as Yuan Yuan, who thus became the masters of all Nomadic Tartary, and were probably nearly related to the later Mongols. I argued in former years that they were identical with the Avars of the European writers, who appear in the West at the time when the power of the Hiong Nu was destroyed.

Presently, in the sixth century, the Yuan Yuan were themselves conquered and replaced by the true Turks, who then appear *eo nomine* for the first time in the Chinese annals. The Chinese, not having the letter "r" in their alphabet, represented the name "Turk" by that of Thukiu. These Turks were, I feel sure, the Western branch of the race above named. They in turn became the masters of all Tartary, and eventually were divided into two sections, a Western branch and an Eastern, the latter being in a large measure the descendants of the Hiong Nu above named.

It is with the advent of these true Turks into Mongolia that we first meet with signs of a settled community there, marked by many traces of civilisation, which are clearly traceable to the Iranian lands from the borders of which these Turks came. Among these the most notable relics are the remains of towns, and the existence of inscriptions, proving their knowledge of letters. They have left us a number of most interesting inscriptions, which have been studied and illuminated by several notable scholars. The names of the rulers mentioned on these inscriptions are also found in the Chinese annals, and are attributed by them to the Thukiu. We can therefore date them with the greatest precision. They are written in the well-known and widely spread Syriac script known as *estranghelo*, in which the Nestorian inscriptions of China were written, and which was afterwards used by the Uighur Turks and the Mongols for their writings. The capital of these early Turks was in Northern Mongolia, and, as stated above, they have left large traces there of their settlements.

Presently it would seem that the earlier Turks who lived in the East and had been known as Hiong Nu reasserted themselves and conquered

and replaced the Turks just named, taking possession of their settlements and capital, and continuing their culture. They also adopted the new name of Uighurs, which the Chinese, having, as I have said, no letter "r," changed into Hoei Hoei and other distorted forms of the name Uighur.

These Uighurs became a highly cultivated people, with a considerable literature, which is still extant, and their dialect is known as Eastern Turki. They apparently inherited from the Western Turks an attachment for the Iranian or Zoroastrian religion, and traces of the Zoroastrian gods and ritual are found among their remains. On other sides their religion was affected by missionaries from other sources. Manicheism found numerous recruits among them, and we are now fast recovering from the buried cities of Eastern Turkestan most interesting remains of the religion of Manes, while the Nestorian clergy founded episcopal sees in their country, and made numerous recruits. Presently, and in the seventh century, Buddhism also made its way among them in the corrupt form, and mixed with the Tantra superstitions, which then prevailed in Tibet, and is known as Red Lamaism in contrast with the reformed Lamaism of the later Yellow Lamas.

At length, in the ninth century, the religion of Islam found its way into Central Asia, being disseminated from the Central Asiatic State governed by the Samanis, and the Western Turks became eager converts to it both in the frontier steppes of the Persian Empire and in Eastern Turkestan. The Eastern Turks or Uighurs continued to be the more cultivated of the race, but the Western were the more powerful warriors, and under the name of Turcomans overran Persia and Asia Minor, founding the famous empire of the Seljuki, which was presently (in the thirteenth century) overwhelmed by the Mongols.

I am conscious of the extremely meagre and arid nature of this epitome, and how little it does justice to the wide reading and sound judgment of the author. No one knows it better, for I have spent a large part of my life in writing four fat volumes on the Mongols, and two sets of papers on the westerly drifting of Nomads and the northern frontagers of China in the old Ethnological Society's Journal and the Asiatic Journal respectively. This may give me at least a claim to speak in terms of high praise of the work before me, in which the author, having the unusual advantage of knowing Russian, has employed it with generous profusion, much to our profit, and in which she describes with clearness the various divisions into which the Turks have been disintegrated, with their geographical, ethnographical, and religious features, and also tells the story of their doings. It is so well done that I cannot pay the book a greater compliment than to repeat my invitation to the learned lady who has written it to give us a much larger work on the subject. I may add that a most ample bibliography occupies 114 of the 242 pages comprised in the work.

HENRY H. HOWORTH.

THE LIVING PLANT.

Botany of the Living Plant. By Prof. F. O. Bower. Pp. x+580. (London: Macmillan and Co., Ltd., 1919.) Price 25*s.* net.

A GOOD deal of discussion has recently taken place among botanists on the subject of the reconstruction of elementary botanical teaching, and one of the main contentions of the originators of the discussion was that in order to secure improvement "comparative morphology should be reduced to a subordinate position." It has further been alleged that in modern botanical teaching the teacher has failed to present the plant as a living organism, thereby implying that morphology has been divorced from physiology. Prof. F. O. Bower has already expressed himself forcibly and with sound sense upon the question in the pages of the *New Phytologist* (vol. xvii., Nos. 5 and 6, p. 105), and has aptly summarised his views with the adage, "Physician, heal thyself."

In his book now under notice he has given so admirable a presentment of the plant as a living organism that instead of there being any antagonism between physiology and morphology, their fusion and interdependence are so impressed on the reader that he can see, not two entities, but "one flesh."

Prof. Bower concludes the article to which reference has been made with the following: "Finally, each teacher with a due sense of his responsibility, and of his opportunities and requirements, must form his own scheme to meet his own needs. If he cannot do this he is not fit for his position."

Prof. Bower has followed this very pertinent criticism with his book, "The Botany of the Living Plant," which is framed on the lines of the annual course of elementary lectures on botany given by him at Glasgow for more than thirty years. His main object has been to present the plant as a living, growing, self-nourishing, self-adapting creature, and he has very finely achieved his ideal.

In his method of treatment of the subject he has allowed the living plant to tell its own story, slowly and naturally unfolding itself stage by stage in such a manner that interest is aroused and observation stimulated. The book may very justly be regarded as an invaluable contribution to sound learning. It does not aim at being an exhaustive treatise, but deals with the fundamental facts of plant life, and is written in a remarkably clear style, so much so that anyone with only a slight acquaintance with plant life should be able to acquire a real knowledge of the science of botany from a careful study of these essays.

The opening chapter is occupied by a careful and comprehensive description of the seed and its germination. It is sometimes considered more reasonable to commence the study of botany with the lower forms of plant life, but it is obviously a better plan to set out with a familiar and easily handled object, such as the seed, which marks a

definite starting-point, and can be examined and studied in detail without recourse to the microscope. It is pointed out that in the plan of construction of the higher plants the outstanding feature is the capacity for indefinite vegetative increase which may be termed "continued embryology."

The cellular construction of the plant and the various functions of the cell, cell-division, and protoplasmic continuity naturally follow, and then the tissues are dealt with in further detail. The sequence of events next leads to an account of leaf and root from the morphological point of view, followed by chapters on the relation of plants to water, and on nutrition, storage, and respiration. In the chapter on growth and movement due attention is paid to the statolith theory in connection with geotropism. Succeeding chapters deal fully with the mechanical construction of the plant body, modifications of form in the vegetative system, such as bulbs, tubers, climbing plants, etc., the irregular nutrition of parasitic, semi-parasitic, and carnivorous plants, and vegetative propagation, all of which aspects of plant life are fully discussed with a wealth of well-chosen examples.

The inflorescence and flower and the formation and development of the seed with all that is entailed occupy some eighty pages and bring this first division of the book to its logical conclusion. This portion is not a mere chronicle of well-known facts, but is illuminated by a consideration of flower colours, pollination, and the details of fertilisation, and closes with a description of the mode of dispersal of some of the better-known seeds and fruits.

The second part of the book is arranged in four divisions, dealing respectively with the Gymnosperms, Pteridophyta, Bryophyta, and Thallophyta, followed by two chapters, one on sex and heredity, the other on the alternation of generations and the land habit. These two essays very fittingly come at the end as a summary of the previous chapters dealing with the life-histories of the lower plants.

As in the earlier part of the book, these more specialised chapters on the ferns, mosses, fungi, and algæ are treated on broad lines, and there is no superfluity of detail to obscure the salient features.

The book concludes with two appendices, one on the types of floral construction in Angiosperms, the other on vegetable foodstuffs, both of which considerably enhance the value of the volume. In the former a few types of flower are described, and notes are added on the natural families to which the particular examples belong. The plants chosen are easily accessible and also represent characteristic features of families the products of which are of economic importance. Further, they are of interest in connection with the production and dispersal of seeds, floral biology, etc. The illustrations in this appendix have been drawn for the most part by Dr. J. M. Thompson, and are particularly clear and useful.

The glossary-index, which completes the book, occupies thirty-two pages, and furnishes a further example of the thorough and careful manner in which Prof. Bower has carried out his object.

We have for so long been accustomed to rely on translations of German text-books for our elementary botanical students that it is very gratifying to find them superseded by so excellent and comprehensive a study of the living plant from one of the most eminent of our own professors and teachers. A. W. H.

OUR BOOKSHELF.

Influenza: A Discussion opened by Sir Arthur Newsholme. Pp. 102. (London: Longmans, Green, and Co., n.d.) Price 3s. 6d. net.

THE discussion on influenza at the Royal Society of Medicine in November last summarises very completely our knowledge of this obscure epidemic disease. Sir Arthur Newsholme, in his opening remarks, expressed the opinion that influenza is a specific disease recognisable in severe outbreaks, and pointed out that, with the exception of plague and cholera, it has on occasion travelled farther and more rapidly over the world than any other recognised disease, and that it is one over which preventive medicine so far has secured little or no control.

Dr. Stevenson directed attention to certain features of the 1918 epidemic which differed from those of the past twenty-seven years, viz. (1) its intensity was greatly in excess of that of any of its predecessors, and (2) the sudden and startling change which occurred in 1918 in the age distribution of influenzal mortality. In all previous years the majority of deaths—generally about 70 per cent.—occurred at ages above forty-five. But in July, 1918, only about 30, and in October about 20, per cent. of the persons dying were more than forty-five years of age, and only 5·5 per cent. of the deaths of this outbreak were at ages above sixty-five, as against an average of 37 per cent. for the years 1890–1917.

Several speakers dealt with the aspects of the epidemic in the Navy and in the Army, and in France, America, and South Africa, which correspond closely with those observed among the civil population here.

With regard to the bacteriology of the disease, most of the observers noted the presence of the influenza bacillus, the pneumococcus and the streptococcus, but no very definite opinion is expressed as to the nature of the virus. Prophylactic vaccination receives scant notice, probably because the data were insufficient at the time of the meeting.

As regards treatment, Mr. E. B. Turner claimed that large doses of salicin constitute a specific, and certainly his experience, based on the observation of 2500 cases, suggests that this drug deserves an extended trial.

R. T. HEWLETT.

The "Daily Telegraph" Victory Atlas of the World. Part i. (London: "Geographia," Ltd., 1919.) Price 1*s.* 3*d.* net.

THIS is the first part of a new atlas to be completed in about forty-eight parts. Each part is to consist of three double-page maps, 20¼ in. by 26 in. A gazetteer is to complete the work. The first part contains maps of Australia (physical), South-West Spain (political), and Germany (historical), besides several inset maps. The colour printing is good and the lettering particularly legible. The orographical map of Australia is layer coloured, and although it shows some small discrepancies from the recently published official orographical map of the Commonwealth it is an effective and useful sheet. The map of Spain, which we take to be the type of political map of the atlas, would be improved by the omission of the "caterpillar" relief, which is merely misleading and of no value. In this respect the map of Germany is better, for no attempt is made to show relief on it. The changes due to the Peace Treaty are incorporated, but a mistake is made in the area of the Slesvig plebiscite. The atlas promises to be a useful one for general reference purposes. Its low price is much in its favour.

R. N. R. B.

The Mica Miner's and Prospector's Guide. By Archibald A. C. Dickson. Pp. viii+50. (London: E. and F. N. Spon, Ltd., 1919.) Price 4*s.* 6*d.* net.

THE mica industry is indebted to the author of this "Guide" for the current system of mining in Kodarma, the most prolific mica field in the world. His memoirs on that field are well known. Any contribution of his to the literature of the subject is therefore sure of careful consideration. The present booklet, which is high-priced—fifty pages for 4*s.* 6*d.*—was prepared to help the increased output of mica necessary during the war. It contains much valuable information, but does not cover all the ground that might be expected from the title. It consists mainly of descriptions of eight of the secondary mines of the Kodarma field and of notes on the mining methods there. It contains little information as to costs and values, and would not explain to a miner who had no previous experience of mica-mining how to estimate the probable profit or loss of a newly discovered deposit. The author's main thesis is that mica-mining must be guided by careful geological study, and he insists that all the facts observable during the working of a deposit should be systematically entered on a mine plan. This warning is especially useful with a branch of mining in which so much of the output is from small mines worked by parties of local labourers. Mr. Dickson points out that the mica lenses on the margin of a deposit are apt to be inclined to the shoot, and a miner who was guided only by the facts seen would be diverted from the main body of mica.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Scattering of Light by Resonating Molecules.

PROF. R. W. WOOD (*Phil. Mag.*, vol. xxiii., p. 689, 1912) found that mercury vapour, even at the small density corresponding to atmospheric temperature, when illuminated by the ultra-violet mercury radiation λ 2536, re-emits this radiation laterally in considerable intensity.

Further, Wood and Kimura found after repeated examination that this radiation is *completely free from polarisation* (*Phil. Mag.*, vol. xxxii., p. 329, 1916).

I have been very much impressed with the contrast between this case, where there is resonance, and the behaviour of gases in general when illuminated by light which is not in resonance with the free period of the atoms. In the latter case the laterally emitted light usually approximates to complete polarisation (Proc. Roy. Soc., A, vol. xcv., p. 155, 1918). What happens as we gradually depart from exact resonance?

Prof. Wood's experiments were made with the exciting light polarised, and he observed the resonance radiation through the same window by which the exciting light entered. In this way the light examined comes chiefly from the very first stratum of vapour entered by the beam. This stratum gives by far the most intense emission.

As, however, the beam advances into the mercury vapour the light in exact resonance is absorbed, being, in part at least, re-emitted. The lateral emission further on is much fainter, and corresponds presumably to a less exact resonance.

It appeared to be of interest to examine this lateral emission from the deeper strata for polarisation. This I have done, and I give here a brief statement of results, leaving the experimental details for later publication.

After the unpolarised primary beam has traversed 0·4 cm. of mercury vapour at ordinary temperature, the lateral emission shows very perceptible polarisation, the component intensity vibrating parallel to the exciting beam having 90 per cent. of the intensity of the perpendicular component.

After passing through 2·5 cm., this ratio fell to 82 per cent.

After 27·4 cm., the value found was 60 per cent.

Thus it appears that the scattered light is unpolarised only when resonance is very exact. The breadth of the absorption band (reversal) produced by a few millimetres of mercury at atmospheric temperature and *in vacuo* must be extremely small, and probably beyond the range of any but the most powerful spectroscopes. Yet it is only within this narrow spectral range of the exciting light that the scattered light is sensibly unpolarised. When this component is filtered out, and such excitation as remains is by light nearer the edges of the exciting line, polarisation becomes conspicuous.

It need scarcely be said that there is very much more to be done in this direction. Further experiments are in progress. RAYLEIGH.

Imperial College, South Kensington,
November 1.

Vertical-pipe Irrigation for Orchards and Market-gardens in Arid Climates.

IN the issue of NATURE for September 11, 1919 (p. 44), abstracting from the *Comptes rendus* of the Paris Academy (August 25, 1919, p. 391), mention is made of a new method, proposed by M. Paul Par-

mentier, for irrigating orchards and market-gardens in Syria, Palestine, and other countries subject to long summer droughts. The observations of M. Parmentier refer especially to the citrus gardens around Jaffa.

In arid climates economy in irrigation-water is obviously of the utmost importance. According to the method proposed by M. Parmentier, the water is applied direct to the roots of each tree by means of earthenware, cement, or iron pipes fixed vertically in the soil. The great losses by evaporation that always occur in open canals and in surface irrigation are thus avoided. M. Parmentier remarks that with vertical-pipe irrigation the water used in a citrus orchard was only 84 litres per hectare, as compared with 600 litres necessary for surface irrigation, applied every five to twelve days. At Jaffa there are 880 trees to 1 hectare (2½ acres) of citrus orchard, and 1100 plants in the banana gardens. These figures are very high, and imply a great consumption of water.

The method proposed by M. Parmentier is not new. Watering orchards by means of special drain-tubes sunk vertically in the soil is an old practice at Messina, in Sicily, where it is chiefly applied to young plantations. This method of irrigation was first described long ago by Prof. Giuseppe Inzenga, the well-known Sicilian agronomist and botanist, in the *Annali di Agricultura Siciliana*; and again by F. Alfonso-Spagna in his "Trattato d'Irrigazione" (Palermo, 1877, p. 502). In my book of agricultural chemistry ("Chimica Agraria, Campestre e Silvana," Napoli, 1902) this special method of drainage-irrigation is again described. The *catuso* used by the Messina gardeners is a conical earthenware pipe, about 1 metre long, open at both ends. The diameter of the upper opening is 15 cm. and that of the lower 10 cm., the pipe thus holding about 12 litres of water. M. Parmentier proposes pipes holding 20 litres for use in orchard irrigation. At Messina the upper end of the *catuso* projects slightly above the soil, the opening being covered with a brick or tile.

In the summer of 1889, at Portici, near Naples, I experimented on two lemon-trees of the same age and size, watering one in the usual manner and the other by means of a drain-pipe sunk vertically in the earth. During that hot summer, in the sandy, volcanic soil at the foot of Vesuvius, the difference between the effects of the two methods of watering was very apparent. The lemon-tree provided with the vertical drainage-pipe prospered on a ration of water about 50 per cent. less than that necessary for the control tree watered from the surface.

The sunk end of the drainage-pipe is made to rest on loose stones or potsherds, which form air-chambers. Thus clogging of the pipe is prevented, and the water that is poured down gets well absorbed and distributed just where the roots are more vigorously developing and renovating their absorbing organs.

The subsoil air-chamber is as important as the water-pipe. During drought the deep aeration of the soil, when moisture is sufficient, provokes the growth of the roots and the renewing of the root-hairs, increasing their power of absorption and at the same time favouring deep-soil nitrification. The roots are induced to develop chiefly around the reservoir of moist, warm air, where respiration and growth find favourable conditions, the network of young and active rootlets thickening around the spot where the watering is concentrated and nitrates are being actively formed. The loss by evaporation and percolation is minimised. Moreover, the close air under the foliage of the trees, as M. Parmentier remarks, is maintained in a less damp condition than is usual in the deeply shaded citrus orchards, where the development of parasites and pests is much favoured by the moist shade.

M. Parmentier observed that vegetables watered by underground irrigation are more tender and of higher market value than vegetables watered by submersion, or by any other method by which the foliage, stalks, and upper parts of the roots are wetted. Indeed, it may be added that the wetting of the foliage increases transpiration, and consequently the waste of water.

By means of vertical-pipe irrigation dilute liquid manure can be applied far more effectually and economically than by the usual method of night-soil manuring. In the case of vegetables and fruit-trees subsoil liquid manuring is also advisable from a sanitary point of view.

In arid climates, and wherever the economy both of water and of liquid nitrogenous manure is of special consequence, the Messina and Parmentier method of underground watering by vertical drainage is much to be recommended.

ITALO GIGLIOLI.
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New Sources of Aluminium.

I WAS much interested in the account given in NATURE of October 23 of the new methods of extraction of aluminium from clays of the kaolin class (formed from the denudation of volcanic rocks) by means of nitric acid and electric furnaces in Norway. When this source of production is generally adopted, as no doubt it will be owing to the diminishing supplies of cryolite and bauxite, it seems probable that the vast quantities of "decomposed porphyry" discovered by the late Prof. Jacob during his geological explorations in the Rocky Mountains (some of which have been mistaken for chalk by prospectors) will then form an inexhaustible source of supply for that valuable metal.

J. E. BACON.
The Barracks, Fulford, York.

Radiation Temperature: Dew.

THE letter in NATURE of October 23 on radiation temperature from Mr. Spencer Pickering reminds me that the theory of the equilibrium temperature is given by Clerk Maxwell in his little-known article on Diffusion ("Ency. Brit.," ninth edition, p. 218). Maxwell shows that in still-air temperature θ_0 a thermometer will gain heat per sec. $4\pi CK(\theta_0-\theta_1)$, where C is the electrical capacity of the bulb, K the conductivity constant for air; and that it will give up heat per sec. $AR(\theta_1-\theta)$, where A is the area of the bulb, R the radiation constant, and θ the temperature towards which radiation occurs. If the bulb be spherical $C=r$, its radius. Consequently,

$$4\pi rK(\theta_0-\theta_1)=4\pi r^2R(\theta_1-\theta),$$

or

$$K(\theta_0-\theta_1)=rR(\theta_1-\theta).$$

That is, the conductivity effect depends on the radius of the bulb. Mr. Pickering has observed this in the case of small bulbs. He goes on to apply this result to small objects, such as the pistils and stamens of flowers. I would like to point out another effect to which his observations apply, namely, that true dew (arising from radiation) is not found on spiders' webs. If webs are examined when dew is on the ground they are found to be dry. When drops of water are found they arise from the collecting action of the webs on mist or fog, *i.e.* by the collection of drops already formed. I have confirmed this on many occasions. I conclude that whenever drops are found on webs it is the result of fog or mist.

SIDNEY SKINNER.
South-Western Polytechnic Institute, Chelsea.

Surface-Tension.

OWING to surface-tension, a surface of mercury supports easily a sovereign placed flat upon it. Care must, of course, be taken to avoid amalgamation.

I shall be greatly obliged if one of your readers will supply me with a formula for determining the size of the largest sphere of gold that can just be supported by mercury. As the numerical solution of the equation may be troublesome, I venture to ask only for the formula. C. T. WHITMELL.

Hyde Park, Leeds, November 3.

Exceptional Dryness of October, 1919.

METEOROLOGISTS have directed attention to the exceptional dryness of the past October. It is also interesting to note that the amount of drainage-water percolating through 20 in., 40 in., and 60 in. of soil in the open field for the month of October as recorded by the Rothamsted Experimental Station gauges is *nil*. The three gauges, each measuring 1/1000 acre, were built in 1870, and in no previous year is October shown quite dry, 1897 being the nearest with a reading of 0·001 in. The following are the figures for October :—

	20 in. gauge	40 in. gauge	60 in. gauge	Rainfall
Average of 50 years	1·848	1·798	1·669	3·233
Max. 1891	5·589	5·716	5·479	6·764
Min. 1897	*nil*	0·001	0·001	0·960
1919	*nil*	*nil*	*nil*	1·073

The 50-year records show that October is one of the four months when the ground is wettest.

W. D. CHRISTMAS.

Lawes Agricultural Trust, Rothamsted Experimental Station, Harpenden, November 6.

SOUND RANGING.

SOUND ranging consists in the location of the source of a sound, such as the report of a gun, by means of measurements made on the sound-wave which spreads from the source. When it seemed probable, in the latter part of 1914, that the struggle in France was going to develop into trench warfare, the possibility of locating enemy batteries by this means was recognised, and many experiments were started independently to find a method of sound ranging which could be used in the field.

Suppose that there is a gun at the point S in Fig. 1. The report of the gun spreads as a spherical sound-wave, with a uniform velocity, and is received by stations at A, B, and C. If the time intervals between the arrival of the sound at A, B, and C are measured, a very simple construction gives the position of the gun. For instance, if the sound gets to B a time t_1 after it gets to A, and to C a time t_2 after it gets to A, circles are described around B and C the radii of which are equal to the distances travelled by sound in times t_1 and t_2 respectively. If a circle is found which passes through A, and touches the circles around B and C, the gun position will be at its centre. Therefore, by installing a series of observation stations along the front at surveyed positions, and recording the times at which the report arrives at these stations, it is possible to plot the position of the enemy battery on a map on which the observation stations are marked. This is the essential idea underlying sound ranging. Three stations only are necessary, but more may be employed in order to confirm the location.

There are other ways of plotting the gun position, given the time intervals. For instance, if the time interval between A and B is t_1, the gun must lie on a hyperbola with foci at A and B which is such that the difference in the distances from the foci of any point on the curve is Vt_1, where V is the velocity of sound. Another pair of stations give another hyperbola, and by finding where this intersects the first the gun position is determined. This was the method actually employed on the plotting-boards used by the sound-ranging sections. The hyperbola approximates so closely to its asymptote near the gun position that the asymptote can be used equally well, which makes the method a very simple one in practice.

The French Army started experiments in sound

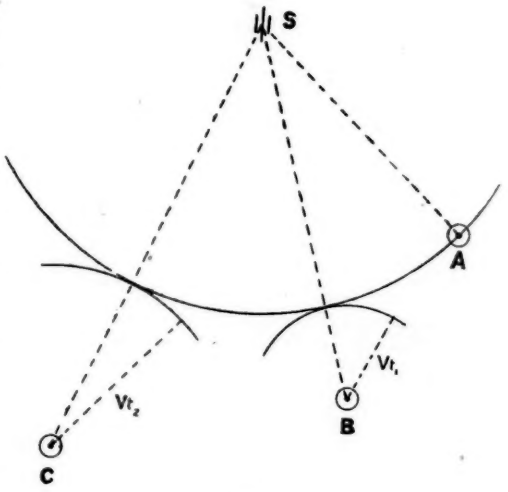

FIG. 1.

ranging in 1914, and obtained results which showed that the method was a promising one. From the very beginning development took place along two lines. Either observers were used, who recorded the time of arrival of the sound by pressing a key, or the sound was registered automatically by some form of microphone. In both cases the stations were connected electrically to a central station, where the signals sent by the observers or microphones were registered on a chronograph of some form. It was soon found that observers were not sufficiently accurate. They made errors amounting to one-tenth of a second, whereas it is necessary to time the arrival of a sound to 0·005 second in order to make a satisfactory location. This accuracy was attained by the system in which the arrival of the sound was registered by a microphone, and both in the French Army and ours a microphone system was finally adopted.

Our attention was directed to the French results in the early part of 1915, and a proposal to form an experimental sound-ranging section was laid before the Experiments Committee at General Headquarters. The committee at first decided against ordering any apparatus, but was persuaded to alter its decision, and an English sound-ranging section was sent to the front in October, 1915. Sound ranging was still in its infancy, and the results obtained were very disappointing. In fact, it was doubtful at one time whether the continuation of the experiments would be authorised. Fortunately, sound ranging just survived these early trials, and during 1916 sufficient sections were formed to cover the whole front.

The apparatus which we adopted was designed by M. Bull, of the Institut Marey, in Paris, and was one of several with which the French Army

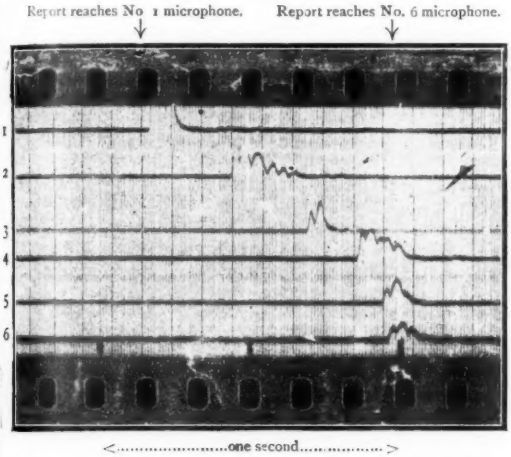

FIG. 2.—The figure is an enlarged print of the record of a 15 cm. howitzer, the report of which has reached No. 1 microphone first and No. 6 microphone last. The film has been moving from right to left while the record was being taken. The time intervals are marked by vertical lines, one hundred to the second, every tenth line being heavier so as to facilitate counting. The horizontal lines represent the shadows of the Einthoven strings, which lie across the slit behind which the film is exposed, and the movements of which are shown on the record.

was experimenting. It is not possible to describe the apparatus fully. The recording apparatus consists of an Einthoven galvanometer with six strings, each string being connected to a microphone at a receiving station. The currents which the microphones send to the recording instrument cause the corresponding strings to vibrate, and their movements are recorded photographically on a moving kinematograph film. At the same time, by interrupting the light which photographs the strings on the film, at intervals of 1/100 second, a series of time markings is ruled on the film, which makes it possible to measure the time interval between the arrival of the sound at two stations. The microphone finally used was of a special type adopted after experiments at the front. Its special feature is that it is very sensitive to sounds of long wave-lengths, such as gun reports or shell bursts (the wave-length of the report of a large gun may be 250 ft.), while comparatively insensitive to ordinary sounds, such as speech, rifle fire, traffic, and so on. The credit of its design is due to Lt. Tucker, an officer serving in the experimental section in 1916.

A record of a German 15-cm. howitzer is illustrated in Fig. 2.

The installation of a section using the Bull apparatus is shown in Fig. 3. There are six microphones, spaced along a "base" about 9000 yards long and 4000 yards behind the front line. These are wired up to a central station which is placed in a cellar or dug-out some 5000–6000 yards from the front line. In front of the base are the "advanced posts." An observer

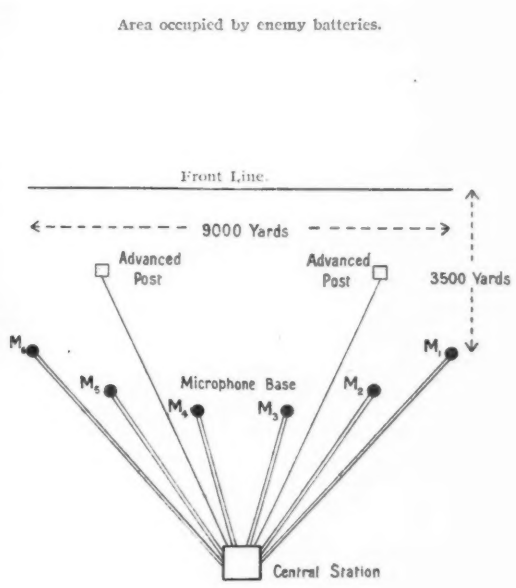

FIG. 3.

is stationed at each of these. When he hears a hostile gun fired, he presses a key which sets in motion the apparatus at the central recording station. The kinematograph film runs through the camera, the lamp is turned on, and all is ready to record any sounds reaching the microphones. Having allowed time for the sound to reach all the microphones, the forward observer raises his key and the recording apparatus stops. He telephones to the central station a report giving his estimate of the direction from which the firing has come, of the target, and of the calibre of the piece. The film is developed and fixed by a

photographer; this can be done in ten seconds by using strong solutions. It is handed over to a computer, who reads the time intervals and plots the result, and the location of the battery is telephoned to all interested. The time taken to work out a result is generally from four to ten minutes after the battery fires. The location is first telephoned to the artillery, in order that immediate action may be taken if desired. The neighbouring sections and other units engaged in location are then informed in order that results may be compared. At the end of the day the section sends in a full report of the day's work, and this is used by the compilation staff employed in estimating the positions and strength of the enemy artillery in any particular sector.

In 1917 and 1918 there were about thirty sections on the Western front, each section having four officers and forty men. The average number of locations obtained per day by each section was about five, though on a day when conditions were particularly favourable it was not uncommon for a section to get thirty, forty, or even more locations. Long spells of westerly weather were responsible for keeping the average number so low, because it was found impossible to "sound-range" in a wind blowing from the base towards the enemy guns. The sound is deflected upwards in the well-known manner, and fails to be recorded by the most sensitive microphone.

The accuracy of the results was tested in many ways. After a successful advance it was possible to examine the positions the enemy batteries had occupied and compare them with the locations. When this could not be done, an examination of aeroplane photographs generally revealed the gun pits, when sound ranging or other methods of location had indicated the approximate battery position. The average error of location, at a range of 10,000 yards, was about fifty yards, though naturally the conditions under which the section was working affected the accuracy greatly. Whenever possible, the aeroplane photograph was relied on to give the exact battery position. The sound-ranging results were especially valuable, however, in that they gave not only the approximate location of the battery, but also its calibre and the target at which it was firing. The shell-burst was recorded as well as the gun report, and so the time of flight of the shell could be found. The character of the report was a clue to the calibre of the piece. The area shelled could be examined to find the shell fragments, and there were other clues to the calibre which made it possible for sound ranging to give very full information about any battery recorded, and this greatly enhanced the value of the locations.

The most serious of the difficulties encountered by the sections were: Confusion between the gun report and the shell-wave which precedes it in the case of a high-velocity shell; inaccuracy caused by ignorance as to the effect of wind and temperature on the sound-wave; interruption by the noise of our own artillery and the enemy batteries; cutting of the lines by shell fire and traffic or by enthusiasts of other units collecting cable of a very useful type; the difficulty of survey of the microphone positions in a country where all landmarks were destroyed; and in the final stages of the war the problem of transporting and installing the section quickly when the line moved every few days. Experience solved these difficulties one by one, and towards the end of the war the sections reached a high state of efficiency, though the limit of development had by no means been attained, and it is certain that they might have played an even greater part than they did in the final struggle.

The British system of sound ranging, founded on the Bull recording apparatus, was developed entirely by officers of sound-ranging sections working at the front. The original experimental section was installed on Kemmel Hill, south of Ypres, and its researches were carried out there. Later, when there were sections along the whole front, it was arranged that an officer from each section should attend a conference which was held every two months. At the conference, proposed improvements were gone into, the equipment was discussed, results were compared, and the report of the discussion was submitted to General Headquarters. This informal conference did more than anything else to improve the work of the sections—it stimulated rivalry and ensured that all proposed alterations in the existing methods were subjected to severest criticism by men who had first-hand experience before they were adopted or turned down. The officers were for the greater part university men who had had a scientific training, and it would not be possible to imagine a more keen and enthusiastic body of men. They were sorely tried in the early days of sound ranging, when they worked under great difficulties, and had yet to prove that reliance could be placed on their results; but they were amply repaid when sound ranging came to its own at the end of the war, and was recognised as one of our most valuable means of locating the enemy's batteries.

RESULTS OF THE TOTAL SOLAR ECLIPSE OF MAY 29 AND THE RELATIVITY THEORY.

THE results obtained at the total solar eclipse of May 29 last were reported at a joint meeting of the Royal and the Royal Astronomical Societies, held on November 6. The stations occupied were Sobral, in North Brazil, and Principe Island. Two cameras were employed at Sobral, the 13-in. objective of the Greenwich astrographic equatorial, and a 4-in. lens, of 19-ft. focus, lent, together with an 8-in. cœlostat, by the Royal Irish Academy. It was realised, before the expedition started, that the cœlostat was scarcely suitable for observations of such extreme precision as were required to detect and measure the small shift in the places of the stars that might be produced by the sun's attraction. War conditions, however, made it impossible to construct

a suitable equatorial mounting, though it is hoped that this may be done before the eclipse of 1922.

The results, to some extent, but, fortunately, not entirely, justified these apprehensions. The eclipse plates taken with the 13-in. (stopped down to 8 in.) are out of focus. Since the focus was good on photographs taken at night a few hours earlier, and also on the check plates taken before sunrise in July, the explanation appears to be a change of figure of the cœlostat mirror, due to the heat of the sun. These plates were compared with the July check plates by using a duplex micrometer. They show an undoubted gravitational shift, the amount at the sun's limb being 0·93″ or 0·99″, according to two different methods of treatment. The probable error, as estimated by the individual discordances, is about 0·3″, but there is reason to suspect systematic error, owing to the very different character of the star-images on the eclipse and check plates. This instrument supports the Newtonian shift, the amount of which is 0·87″ at the limb. There is one mode of treatment by which the result comes out in better accord with those of the other instruments. Making the assumption that the bad focus did not alter the scale, and deducing this from the July plates, the value of the shift becomes 1·52″.

The results with the 4-in. lens are much more satisfactory. The star-images are well defined, and their character is the same on the eclipse and check plates. As the duplex micrometer would not fit these plates, a key-plate, on which the film was placed away from the lens, was taken in July, and all the plates in turn were placed in contact with this plate and compared with it. The resulting shift at the limb is 1·98″, with a probable error of 0·12″. The values from the separate stars are in good accord, and they support the fact of the shift varying inversely as the distance from the sun's centre; they are thus unfavourable to its being due to refraction, as was suggested by Prof. Newall at the meeting. Moreover, Prof. Lindemann pointed out that the comets of 1880 and 1882 had traversed this region without giving the slightest evidence of having encountered resistance; as their speed was about 300 miles per second, a vivid idea is given of the extreme tenuity of any medium that they encountered.

The Principe expedition was less fortunate in the matter of weather, but a few plates showed five stars. Since no check plates of the eclipse field could be taken there, another field near Arcturus was photographed, and both it and the eclipse plates were compared with plates of the same fields taken at Oxford with the same object-glass. It was, moreover, necessary to assume that the scale of the eclipse plates was the same as that of the check plate. This is justified by the fact that the diurnal variation of temperature in Principe is only some 4° F., and that there had been no bright sunshine on the mirror before totality. The measures indicate a shift at the limb of 1·60″, with a probable error of 0·3″.

It will be seen that the mean of this result and that with the 4-in. at Sobral agrees very closely with Einstein's predicted value 1·75″. It was generally acknowledged at the meeting that this agreement, combined with the explanation of the motion of the perihelion of Mercury, went far to establish his theory as an objective reality. Sir J. J. Thomson, who presided, spoke of the verification as epoch-making; he suggested that it would probably have a bearing on electrical theory, but he regretted the very complicated form in which Einstein expressed his theory, and hoped that it might be possible to put it into a form in which it would be more generally comprehensible and useful.

Dr. Silberstein laid great stress on the failure to confirm Einstein's third prediction, that of the displacement of lines in the sun's spectrum towards the red, to the amount of 1/20 Ångström unit; this had not been verified, in spite of the careful search made by Dr. St. John and Mr. Evershed. As the probable error of their measures was much less than the quantity predicted, he looked on this result as final; some people had suggested that the shift might be veiled by a systematic outward movement of the photosphere, but as Dr. St. John made measures both at the sun's centre and limbs, that suggestion was not tenable. Prof. Eddington admitted that the failure threw doubt on the validity of some of the steps which led Einstein to his gravitational result; but he contended that the two other successes indicated that the result was right, even if reached by a wrong method.

There was some discussion on Prof. Lindemann's method of photographing stars in daylight by the use of red screens. However, the eclipse method seems more trustworthy, and the Astronomer Royal expressed the hope that the eclipse of 1922 might be observed with equatorials. The star-field is not so rich as in the late eclipse, but with longer exposure much fainter stars could be recorded. The eclipse-track crosses the Maldive Islands and Australia, and is therefore fairly accessible. A. C. D. CROMMELIN.

THE JUBILEE OF "NATURE": CONGRATULATORY MESSAGES.

IT is with a certain amount of diffidence that we give here a number of cordial messages which have reached us upon the attainment of the fiftieth anniversary of the foundation of NATURE. We believe, however, that many readers will be interested not only in the friendly greetings expressed in these messages, but also in the references to the work of science, and its expanding field of usefulness. To the official representatives of scientific societies and university institutions, and to the other men of light and leading who have honoured us with their congratulations, we offer our sincerest thanks. Such appreciation of past efforts affords the strongest stimulus to future endeavour.

While NATURE has the advantage of the active

interest and co-operation of so many distinguished leaders in the world of science, the columns of the journal will continue to represent with authority the position and claims of progressive knowledge. In sending us best wishes for continued fulfilment of this function, Dr. Hilda Brade-Birks and the Rev. S. Graham Brade-Birks, of the South-eastern Agricultural College, Wye, refer us to some striking verses in the seventh chapter of the Wisdom of Solomon in the Apocrypha, and the words are of such interest as expressing the human outlook upon natural knowledge that we are glad to reproduce them :—

God hath granted me to speak as I would, and to conceive as is meet for the things that are given me: because it is He that leadeth unto wisdom, and directeth the wise.

For in His hand are both we and our words; all wisdom also, and knowledge of workmanship.

For He hath given me certain knowledge of the things that are, namely, to know how the world was made, and the operation of the elements:

The beginning, ending, and midst of the times: the alterations of the turning of the sun, and the change of seasons:

The circuits of years, and the positions of stars:

The natures of living creatures, and the furies of wild beasts: the violence of winds, and the reasonings of men: the diversities of plants, and the virtues of roots:

And all such things as are either secret or manifest, them I know.

Scientific and Other Societies.

Royal Society. *President:* Sir Joseph Thomson, O.M.—The council of the Royal Society offer to the Editor and publishers of Nature their congratulations on the fiftieth anniversary of the publication of that journal. They desire to express their appreciation of the services rendered to science by Nature during the past fifty years, both by the promotion of research and especially by providing an efficient and convenient means for workers in one branch of science to keep in touch with the progress made in other departments of scientific activity. They recall with satisfaction the fact that the jubilee of the election into the society of their distinguished fellow, Sir Norman Lockyer, coincides with that of his jubilee as Editor of Nature.

Royal Society of Edinburgh. *President:* Dr. John Horne, F.R.S.—I am glad to have the opportunity of expressing my high appreciation of the invaluable services rendered by Nature in promoting scientific research in Scotland during the last fifty years. In 1862 a distinguished Scottish man of science deplored the progressive decay, during the previous half-century, of the once illustrious Scottish school of geology. Since that time the progress in each department of geological investigation in Scotland has been remarkable through the labours of English and Scottish geologists. The publication of Nature has been a powerful stimulus to geologists and other men of science in North Britain to test all previous work in the light of the most recent research.

Royal Irish Academy. *President:* The Right Hon. and Most Rev. J. H. Bernard, D.D., D.C.L., Provost of Trinity College, Dublin.—The jubilee of Nature marks the completion of fifty years' useful aid to science, and the proprietors are heartily to be congratulated on the fruitfulness of their undertaking. The application of science to the practical needs of mankind is taking a wider range every year, and the president of the Royal Irish Academy wishes all success to the Editor of Nature in his efforts to encourage and give publicity to the aims of scientific research and its importance to the nation.

Royal Dublin Society. *Vice-President:* Prof. J. Joly, F.R.S.—In furthering scientific progress, Nature has played no small part, for it has supplied a vital necessity: early publication of new ideas, new results, and new projects. We who now write know that our earliest efforts found encouragement in its columns. May the early efforts of our successors continue to gather from its columns the same encouragement and the same stimulus! Looking back, we recognise and acknowledge that Nature has played an important part in our lives.

Royal Anthropological Institute. *President:* Sir Everard im Thurn, K.C.M.G.—The council of the Royal Anthropological Institute has commissioned me to convey to the Editor of Nature very hearty congratulations on the jubilee of that journal and on fifty years' successful furtherance of science generally, and not least of anthropology. Our subject may be said to have developed during the same period from a merely interesting to a scientific stage. We anthropologists foresee a very special task lying before us in the immediate future, in the betterment of the almost innumerable races included in our world-wide Empire. We look to Nature for continued and increased help in the furtherance of this work.

Royal English Arboricultural Society. *President:* Major G. L. Courthope.—May I offer my congratulations to Nature upon attaining its jubilee, and upon the excellent work it has done, during its fifty years of life, in the promotion of scientific study? The passing of the Forestry Act opens a fresh vista of useful possibilities to the student of natural science—a vista in which, I am sure, Nature will play its part. In the United Kingdom scientific forestry has been the rare exception rather than the rule, with the result that our 3,000,000 acres of woodlands produce only a fourth of the yield which we might expect from them if scientific principles had been applied to the varying natural conditions of our countrysides. Let us hope that the next fifty years will make up for our shortcomings in the past.

Royal Institute of British Architects. *President:* Mr. John W. Simpson.—Many congratulations will be received on the issue of the jubilee number of Nature, and I shall feel privileged by being allowed to add my own tribute. The journal has achieved a great position in the scientific world by reason of its sane and unprejudiced attitude towards research; and, in common with all highly specialised technical callings, the architectural profession is greatly indebted

to it. To the Science Standing Committee of the Royal Institute, and its various committees which are occupied with scientific research into matters connected with heating, lighting, construction, and building materials, NATURE is especially valuable. Pray accept my sincere good wishes for a long-continued prosperity.

Royal Astronomical Society. *President:* PROF. A. FOWLER, F.R.S.—The field of scientific investigation is ever widening with the advance of knowledge, and those who are engaged in research are fortunate in being always able to look with confidence to NATURE to keep them well-informed as to the latest developments in their own and other branches of science. By its timely announcement of approaching phenomena and its record of current work and thought the journal has rendered important services to astronomers, and can scarcely have failed to stimulate an intelligent general interest in the results of their work.

Royal Engineers Institute, Chatham.—The president and council of the Royal Engineers Institute offer their most sincere congratulations to NATURE on the attainment of its jubilee. They recognise with a lively sense of appreciation the high standard consistently set in its columns. They offer the Editor their thanks that he has never failed to enforce the great lesson: that the search for knowledge, pursued for its own ends and with no immediate thoughts of material gain, should be one of the most potent driving forces in the life of a nation. Without this impulse no material advance in civilisation is possible. Now at the present time, at the end of a devastating war which finds many exhausted and some despairing of the future, it is more than ever necessary to hold this beacon aloft and to convey a message of encouragement to all workers engaged in the great search for natural knowledge, bidding them remember that, whatever be the temporary distractions of the time, they should never lose sight of the central truth: that with them lies, in no small degree, the future of the world.

Royal Horticultural Society. *Chairman of Council:* MR. HARRY J. VEITCH. *Secretary:* REV. W. WILKS.—Like most ancient arts, the practice of horticulture was rooted in tradition and hedged about by empiricism. Advancing knowledge gradually lets in light upon its many branches, stimulates its dormant buds into growth, and surrounds its roots with the vitalising environment of experiment. It is an art that lays all Nature under contribution; that can flourish best where knowledge of Nature is deepest. In the name of British horticulturists we congratulate NATURE, which has done so much to spread knowledge, upon its fifty years of usefulness, and wish it and those whose work it tells of continued diligence and success.

Royal Society of Medicine. *From the* PRESIDENT.—During the fifty years that NATURE has provided a weekly summary of science the changes in medicine, particularly as regards diagnosis and treatment, have been without parallel. This is shown by a comparison of the toll of disease, on one hand in the late war, and on the other in the Crimean, North and South, and Franco-Prussian Wars. The changed picture is due to the practical application of science. Pasteur's researches gave us bacteriology and a knowledge of the nature of infection, and rendered possible the modern treatment of wounds, introduced by Lister, and the use of serums and vaccines. The diagnostic and therapeutical use of X-rays, the employment of radium, and many other advances are further gifts from science. But this transformation of medical practice only reveals a multitude of important problems concerned with the prevention, early detection, and effective treatment of disease, and for their solution we must look to scientific research.

Royal College of Surgeons. *President:* SIR GEORGE H. MAKINS, G.C.M.G.—The realm of science may well acclaim the jubilee of NATURE, and no less all those concerned in the promotion of the public good. The occasion arrives opportunely, for at no time has the public sense been so forcibly awakened to the influence of the applications of science to such divergent objects as trade, medicine, war, or the feeding of the population. If important changes founded on the progress of science are to be effectively introduced, those who will be affected must be educated and prepared beforehand. In this great work NATURE has taken and must take a prominent part, an aim no less wide-reaching than that of bringing students in every branch of science into association and establishing a common bond of sympathy and mutual understanding between them.

Royal United Service Institution. *Chairman of the Council:* ADMIRAL SIR F. C. D. STURDEE, BART., K.C.B., K.C.M.G., C.V.O.—As chairman of the council of the Royal United Service Institution, I wish to convey the congratulations of the council and myself to the proprietors and Editor of NATURE on attaining its jubilee. We all recognise the excellent service that the journal has rendered to science during the last fifty years. Science, while aiming at the development of human progress, was ready to turn its thoughts and genius to helping the Empire in its time of trial. This fact is most thoroughly appreciated by the Navy, Army, and Air Force, and as one of their representatives I wish to express my thanks, and trust that NATURE will continue its help to the fighting Services for the defence of the Empire.

Highland and Agricultural Society of Scotland. *Chairman of Directors:* MR. CHARLES DOUGLAS, C.B.—It gives me great pleasure to congratulate the Editor of NATURE on the attainment by that journal of its jubilee. Writing as a representative of the agricultural industry, I desire to acknowledge the immense benefits which that industry has received from the development of science, and especially in the field of chemistry. It is universally recognised that the future success of the industry depends in large measure on the further application of scientific discovery. Both fundamental and practical research in bacteriology promise to give invaluable results, whether in the near or remote future; and the further development of engineering in its application to agriculture offers great prospects of economy and increased efficiency in production. I offer my most sincere good wishes for the future of NATURE.

Society of Public Analysts and Other Analytical Chemists. *President:* DR. SAMUEL RIDEAL.—As president of the Society of Public Analysts, I beg to offer you congratulations on reaching the jubilee of NATURE. The journal has always been the pioneer of scientific progress in this country, and has contributed not a little in its development at the present time. It looks as if the Government and the daily Press are still far from realising what the promotion of science and its value to the national needs means. Members of my society, who are for the most part Government officials under Acts passed so long ago as 1875, a few years after your first number appeared, have recently been, I believe, transferred to a new Government Department, the Ministry of Health, which starts on its new career, like its predecessor, without any adequate representation of pure science on its councils. Your weekly numbers must have a beneficial effect upon the national development, and I hope that your circulation will increase and that the knowledge which you reveal will be assimilated and rendered more and more available for the general good.

Anatomical Society of Great Britain and Ireland. *President:* PROF. ARTHUR KEITH, F.R.S.—NATURE is the link which binds British men of science together. It is essential, and I wish it long life and prosperity.

Institution of Automobile Engineers. *President:* MR. THOMAS CLARKSON.—A lover of science is content to follow devotedly the object of his affection regardless of whether his revenue is likely to be speedily augmented thereby. He should, nevertheless, take a broad view that does not exclude the consideration of probable benefit to the community as a result of his endeavours. In other words, the true man of science is a public servant in the widest sense, and his work is directed to bettering the conditions of life, reducing its toil, evil, and "dis-ease," while increasing its pleasure and charm: for example, by adding to our knowledge and power of controlling the forces and amenities of Nature; by solving the problem of increased production with greater leisure to the worker; by increasing cultivation; by reducing the cost of transport, and thereby facilitating intercourse.

Biochemical Society. DR. ARTHUR HARDEN, F.R.S.—The recognition of biochemistry—linked on one hand with chemistry, and on the other with biology—as a distinct branch of science has gradually come about during the half-century covered by the publication of NATURE. To students of this borderland science NATURE, with its comprehensive and impartial treatment of the physical and biological sciences, has always been of special value, bringing within their reach the opinions and discoveries of other workers, whose results, obtained in fields beyond their own boundaries, are yet of great interest and often of supreme importance to them. It is precisely this universality of scientific interest which constitutes the chief value of NATURE to the investigator, and as long as this is maintained, so long will the journal continue to flourish and earn the gratitude of its scientific readers.

British Academy. *President:* SIR F. G. KENYON, K.C.B.—The jubilee of NATURE is not a matter of interest to students of natural science alone. It is, I hope, generally recognised now that the interests of science and of the humanities are not hostile, and that the welfare of the nation depends on the advance of knowledge in both these spheres, and in a fuller recognition of the necessity of both. NATURE, I am sure, under its present administration, will, without prejudice to the subjects with which it is specially concerned, continue to advocate the cause of knowledge and intellectual culture as a whole; and all friends of the humanities will wish it God-speed.

British Association. *President:* SIR CHARLES A. PARSONS, K.C.B., F.R.S.—The British Association sends its most cordial greetings to NATURE on the completion of its fiftieth anniversary. The influence of NATURE on the advancement of science for half a century has been wide and comprehensive, and a powerful factor in popularising scientific thought and progress. To men of science also it has been of great assistance by chronicling contemporary progress in the advance of the sciences and arts, and has been a medium for the interchange of information, knowledge, and ideas.

Chemical Society. *President:* SIR JAMES DOBBIE, F.R.S.—The advance of chemistry takes place to-day along a front which has been enormously extended since the first number of NATURE was issued. Moreover, it is supported by forces so vastly superior in number, in organisation, and in equipment to those existing in 1869 that scientific workers may go forward in the confident anticipation that the progress of the next fifty years will be even more wonderful than that of the half-century which has witnessed the elucidation of the constitution of the most complex organic compounds and the formulation of the periodic law, and has revealed the structure of the atom. Amongst the agencies to which the improvement of the position of science in this country is due NATURE takes an important place, not only by the opportunities it has afforded scientific men for interchange of views, but also by the force and persistency with which it has advocated the cause of scientific education and brought the claims of science before the attention of the Government.

Institute of Chemistry. *President:* SIR HERBERT JACKSON, K.B.E., F.R.S.—It gives me very great pleasure to offer, on behalf of the Institute of Chemistry, hearty congratulations to NATURE on fifty years of work in the best interests of science. At no part of that period has the importance of applying science to industry been more evident than it is to-day, and at no time, perhaps, has it been more abundantly clear that sound and broad training in pure science is imperative if real progress is to be made in its applications. May NATURE flourish and continue to spread knowledge of science, to show its necessity in education, and to point out how prolific a source it is of benefits to mankind.

Institution of Electrical Engineers. *President:* MR. ROGER T. SMITH.—NATURE attained its jubilee within a few days of the first full meeting of the International Electrotechnical Commission held since peace was signed. Well-known electrical engineers representing twenty-one foreign countries

met in London to standardise, for those nations participating, some of the fundamental constants and relations on which the applications of electrical science to industry depend. NATURE throughout its career has stood in the first place for pure science, and since most of the important applications of science to industry have grown from the discoveries of the worker in pure science, I recognise the high standard of NATURE's work and of its ideals, and hope that both may long continue in the same happy combination.

North-East Coast Institution of Engineers and Shipbuilders. *President:* MR. A. ERNEST DOXFORD.—I have the greatest pleasure in congratulating NATURE upon the attainment of its fiftieth birthday. Throughout the past half-century the journal has maintained its character as the organ of workers in fields where science is studied mainly for its own sake, and has refused to sacrifice accuracy to the demands of what is understood as "popular" science. It is a healthy sign that the periodical should be so prosperous, testifying to the existence of a constant and active desire for British scientific literature of a high standard. I sincerely wish continued prosperity to the good work which NATURE is undoubtedly doing. The development of the journal along its present lines cannot but be beneficial to scientific progress.

Institution of Engineers and Shipbuilders in Scotland. *President:* DR. T. BLACKWOOD MURRAY.—As president of the Institution of Engineers and Shipbuilders in Scotland, allow me to express our congratulations on the occasion of the jubilee of NATURE. While perhaps the journal, dealing as it does largely with questions of pure science, may be said to be at the extreme pole from that occupied by the intensely practical applications of science which form the life-occupation of us engineers, still I think every day it is being more and more realised that it is largely due to the pioneer in pure science that we owe all modern developments in engineering. The worker in pure science may be likened to the explorer making excursions into virgin country, while we follow along after as the builders of towns and founders of industry. The day has passed when the practical engineer was inclined to scoff at science and theory, and was too prone to point to apparent contradictions of practice as against theory. Nowadays no engineer can hope to succeed unless he takes advantage of all that science can teach him. It therefore gives me much pleasure to take this opportunity of wishing NATURE continued prosperity.

Faraday Society. *President:* SIR ROBERT HADFIELD, BART., F.R.S.—It is with much pleasure I learn of the jubilee of NATURE—a publication which has done so much in the past to assist science and scientific development; in fact, its name has been a household word throughout the world. I should like to offer my best wishes for the future success of this valuable aid to those who strive to promote science and scientific interests. There never has been a time in the history of our nation when it was more desirable that the best possible stimulus should be afforded to those who guide the destinies of the British Empire in educational matters, especially matters relating to science and its development, which surely in the near future will have its proper position allotted to it in our Government Departments and establishments. It has been well said that, of developments in such Departments, Science is the "Cinderella." It is therefore to be hoped that steps will be taken to remedy this crying injustice, which is so damaging to the true interests of the nation.

Geological Society. *President:* MR. G. W. LAMPLUGH, F.R.S.—During the past fifty years NATURE has faithfully mirrored for us the advance of science all along the line, and epitomised and discussed the new results, both observational and speculative. It has enabled the individual worker to keep in touch with the main currents of progress in branches other than his own; moreover, it has served him as a general chronicler of happenings in the sphere of science, and has gratified his desire to know something about the personality of the leading investigators, past and present. I congratulate the Editor on the sustained skill with which the complex task has been accomplished, and I look forward with confidence to its successful continuance.

Illuminating Engineering Society. *President:* MR. A. P. TROTTER.—Maxwell, at the British Association meeting in the year after NATURE first appeared, referred to the reciprocal effects of the progress of science. "When the student has become acquainted with several different sciences, he finds that the mathematical processes and trains of reasoning in one science resemble those in another so much that his knowledge of the one science may be made a most useful help in the study of the others." The expansion of all branches of science in these fifty years has compelled most of us to specialise, not in one branch, but in a bough or a twig of the tree of knowledge. The pages of NATURE have enabled this broad acquaintance to be made and this useful help to be rendered, not only between mathematics and physics, but also between all the natural sciences.

Institute of Journalists (Scientific and Technical Circle). *Chairman:* MR. LEON GASTER.—I gladly take this opportunity of congratulating NATURE on the attainment of its jubilee, and expressing my great appreciation of the work it has done, and is doing, for the promotion of science and the encouragement of education. NATURE in many respects occupies a unique position. It speaks with an authority on scientific matters that is unrivalled; it has been fortunate in enlisting the help of experts in every field of science; and its treatment of subjects is invariably up to date. At the same time its outlook is sufficiently broad for it to interest many persons outside strictly scientific circles, and thus to promote that general appreciation of the value of science which is so essential in these times. I am sure that this useful record of work, extending for fifty years, has established the position of NATURE as a permanent and indispensable publication in the interests of the advancement of science.

Linnean Society. *President:* DR. A. SMITH WOODWARD, F.R.S.—The president and council of the Linnean Society desire to associate themselves in the congratulations due to the Editor and publishers of

NATURE on the attainment of the jubilee of the journal. It is a noteworthy achievement of British science to have maintained for fifty years an organ of intercommunication for scientific workers perused and recognised by the men of learning of all nations. In these modern days of high specialisation it is more than ever important that those engaged in research should have the easy access to a summary of all current progress, such as NATURE affords, and naturalists unite with other men of science in expressing their best wishes for the continued success of the weekly publication to which they are already so much indebted.

Manchester Literary and Philosophical Society.—The council of the Manchester Literary and Philosophical Society desires, on the occasion of the completion of fifty years issue of NATURE, to express its high appreciation of the valuable aid which that journal has given to the development of science during that period. The council hopes and believes that the high standard of the reviews, reports, and original articles which has always characterised the journal in the past will be fully maintained in the future, and that with the growing recognition of the vital importance of scientific knowledge the journal will exert a constantly increasing influence for the diffusion of true learning.

London Mathematical Society. *President:* MR. J. E. CAMPBELL, F.R.S.—The London Mathematical Society is just four years older than NATURE; in the early days and later the work of the society was promoted by a brief report of its activities in that journal. The volumes of NATURE with their indexes, especially the earlier ones, have permanent value as one of the most effective sources of reference for the general history of scientific progress in the last half-century. It is much to be desired that this very essential service to the scientific world may be maintained unimpaired.

Institution of Mechanical Engineers. *President:* DR. EDWARD HOPKINSON, M.P.—The jubilee of NATURE is an event of more than passing interest. During the last fifty years NATURE has been a potent factor in the diffusion of scientific knowledge. The realm of science is vast. Its boundaries are being constantly pushed further into the unknown. Of necessity, scientific workers must become more and more specialised in particular lines of research, and they need the help of some organ through which they can watch the progress of science in general. Such a survey NATURE has provided, always up-to-date and always discriminating, and in so doing has helped to raise the status and strengthen the fellowship of scientific men throughout the world. To a much wider circle of men engaged in profession and industry, whose daily work is so exacting as to preclude serious scientific study, NATURE affords the opportunity of keeping in touch with scientific discovery and thought. Lastly, NATURE has done much, though much remains to be done, towards convincing our administrators and politicians that to neglect science and to fail to act upon its precepts is to doom the national life to decay.

Mineralogical Society. *President:* SIR WILLIAM PHIPSON BEALE, BART.—Among the many scientific societies which will be moved to express gratitude and goodwill on the occasion of the jubilee of NATURE the Mineralogical Society of Great Britain and Ireland finds a place. The society was founded in February, 1876, under the presidency of Henry Clifton Sorby; and in December, 1883, under the presidency of Prof. Bonney, it absorbed the Crystallological Society. It is a proud thing to be able to say, in recalling these two names, that the society has seen, and taken some part in, the development of the domain of the mineralogist and crystallographer into the wide fields of molecular physics, the exploration of which has been the most marvellous work of distinguished men of science in recent years. It is equally pleasant to recognise the co-operation of NATURE, associated with the name of Lockyer, in stimulating interest in, and sustaining the work of, such research, cultivating the ground some years before the Mineralogical Society came into existence.

Institution of Mining and Metallurgy. *President:* MR. HUGH K. PICARD.—For fifty years NATURE has provided a link between workers in the fields of pure and applied science. During the war the achievements of chemistry and metallurgy, many of which have been recorded in its pages, were nothing short of astounding; indeed, no branches of scientific learning were more thoroughly tested or gained greater victories over almost insuperable difficulties. Urgency demands that *results* should be secured at any cost; consequently economics had to take second place. In the coming peaceful fight for the world's trade the metallurgist and chemist are faced with a new set of difficulties brought about primarily by the high costs of fuel and labour. They cannot look forward to well-earned rest, but must devote themselves anew to the problem of reducing the cost of production, always having before them the important economic factors which can no longer be put in the background.

Optical Society. *President:* PROF. F. J. CHESHIRE.—There is only one NATURE, as there is only one *Punch*—each supreme in its own sphere.

Institution of Petroleum Technologists. *President:* SIR FREDERICK BLACK, K.C.B.—In earlier days men with scanty knowledge, if any, of science found, and in crude fashion utilised, natural petroleum. To-day large production and economical utilisation demand the services of the geologist, the chemist, and the engineer, all of whom have a common platform in the pages of NATURE. The geologist, by his study of strata, directs effort to the more likely places. The chemist, by research and analysis, ascertains the proportions and properties of the constituent fractions of the crude oil. The applied science of the engineer and the chemist turns laboratory methods and apparatus into those of the commercial refinery. Contrast the early crude methods with those of to-day, and some realisation will result of the work already done by science in guiding the utilisation of a great gift of Nature. The field for similar effort is still great.

Physical Society. *President:* PROF. C. H. LEES, F.R.S.—As president of the Physical Society I desire to offer

my congratulations to NATURE on attaining its jubilee. There are, unfortunately, few physicists left who read the first number on its appearance, and it is hard for those of us who have grown up to expect NATURE as regularly as Friday morning to realise how difficult it was fifty years ago to get trustworthy information on any scientific subject of special interest at the moment without going to original sources and reading at great length. To the specialist who is anxious to keep in touch with the world of science outside his own groove NATURE comes as a refresher, and to the general reader who finds his daily paper too untrustworthy on scientific matters it is an invaluable authority.

Physiological Society. PROF. W. D. HALLIBURTON, F.R.S.—The Physiological Society has no president, and has never had one. At a recent meeting of the society I was deputed (as the oldest member present) to convey to the Editor of NATURE our hearty congratulations to that journal on having reached its jubilee, and to thank its staff for all they have so successfully done in the promotion of scientific interests during the last fifty years. The position of science to-day is very different from what it was in 1869. There still remains much to be done in the education of the public in reference to the value of science to the nation at large, but we anticipate that in the future, as in the past, NATURE will occupy a prominent place in this branch of education. The recent war has during the last five years brought home to the people a keener appreciation of the national value of science than the preceding forty-five years of peace, and in the time of "reconstruction" now entered upon all will hope that both rulers and ruled will realise and act upon the imperative nature of the study of science, both pure and applied, if our efforts to make the world a better place are to be successful. The Physiological Society desires me to allude in conclusion, when sending a message to a literary journal, to the fact that it also has undertaken the publication of a periodical entitled *Physiological Abstracts*, by means of which its own particular part of the gospel may be spread. It was a direct outcome of the powerful stimulus of war, and we trust when the time of its jubilee arrives it may be able to show as good a record as its elder sister NATURE.

Röntgen Society. *President:* GEORGE B. BATTEN, M.D.—"Work is worth doing for work's sake." Twenty-four years ago Röntgen, following the work of Crookes and Lenard, discovered X-rays, and a translation of his paper appeared in the columns of NATURE (January 23, 1896) within a few days of the announcement of the discovery. In less than a quarter of a century the discovery has been of inestimable benefit to mankind not only in diagnosis and treatment, but also in metallurgy, and has created quite a new and extensive industry. Moreover, the investigation by Rutherford and a host of workers of the properties of X-rays and of the kindred rays of radioactive substances has increased our knowledge to such an extent that our conceptions of the ultimate constitution of matter and of the universe have been enlarged and revolutionised.

FOREIGN ACADEMIES AND SCIENTIFIC SOCIETIES.

Belgium.

Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique. *Permanent Secretary:* M. PAUL PELSENEER.—It is a great satisfaction for the Royal Academy of Sciences of Belgium to greet the first jubilee of NATURE. The Academy highly appreciates what NATURE has done for the promotion of science, especially in helping the speedy diffusion of the most important discoveries in every department. The Academy wishes the next period of fifty years to be still more fruitful, and that NATURE may assist scientific progress in the future as much as in the past. The Academy thinks that the "Entente Cordiale" of the inter-Allied academies and the newly instituted International Council for Scientific Research, in Brussels, will be, by a methodical co-ordination of work, the best and quickest means of promoting scientific knowledge. Lastly, the Academy thinks all scientific workers understand that it is urgent to compensate for five years' interruption by a renewal of activity and production.

France.

Société d'Encouragement pour l'Industrie nationale. *Le Président:* M. L. LINDET.—La Société d'Encouragement pour l'Industrie nationale a suivi avec intérêt les publications scientifiques du journal NATURE; elle y a souvent rencontré des articles de science industrielle dont elle a fait son profit, en même temps qu'elle se félicitait de voir NATURE faire à son Bulletin des emprunts fort bien sélectionnés. Son ancienneté, qui remonte à 1801, lui donne toute autorité pour souhaiter à NATURE, aujourd'hui cinquantenaire, une longue et glorieuse existence.

Société de Géographie, Paris. *Le Président:* LE PRINCE BONAPARTE, DE L'INSTITUT DE FRANCE. *Le Secrétaire Général:* M. G. GRANDIDIER.—La Société de Géographie ne saurait demeurer indifférente à la célébration du cinquantenaire de NATURE. En effet, depuis le jour où elle a commencé de paraître, NATURE s'est toujours intéressée à la géographie; elle lui a fait sa place parmi les sciences dont elle s'occupait, et, par nombre d'études publiées dans ses différents fascicules, elle a, d'autre part, indirectement contribué à ses progrès. Aujourd'hui, NATURE peut encore agir de même, et même plus efficacement que jamais; il n'y a plus à réaliser de grandes découvertes géographiques; mais, par contre, que d'études minutieuses sur le relief, le climat, la flore, la faune, l'homme aussi, s'imposent aux travailleurs! En publiant des travaux originaux, en donnant les conclusions des principaux mémoires parus ailleurs, NATURE continuera de bien servir la géographie après 1919, exactement comme elle l'a fait précédemment, durant le demi-siècle écoulé depuis 1869.

Holland.

Dutch Academy of Sciences, Amsterdam. *President:* PROF. H. A. LORENTZ.—On the occasion of the jubilee of NATURE I have great pleasure in expressing my high appreciation of the important services it has rendered to science during the fifty years of its existence. The

wonderful progress that has been made in all directions has been faithfully recorded in the columns of this journal, which has been a most valuable source of information and a great aid in their work to scientific men all over the world. I heartily hope it may remain so for many years to come.

Norway.

Bergens Museum. *President:* DR. JOHAN LOTHE.—During the war natural science amply proved what immense powers it wields and what great ends it can attain. In the work of reconstruction and peaceful development which is before us we shall look with greater expectations to science and to the results of scientific research. A highly trained staff of scientific workers, with well-furnished laboratories at their command, will then be an invaluable asset to any nation. At the same time we may entertain a hope that science, which is of necessity international, will in course of time be able to renew the bonds of international intercourse and co-operation which have been broken by the war, and thus enable mankind to bring the work for peace among nations to a happy end.

Portugal.

Academia das Sciências de Lisboa. *President (Class of Sciences):* JOSÉ JOAQUIM DA SILVA AMADO.—The great advances of science since the second half of the eighteenth century which are enjoyed by us, and the benefits of which are increasing every day, have been the result of three essential conditions, namely:—(1) The progressive triumph of the freedom of thought over the old tyranny of a dull scholasticism and its metaphysics, by which intellectual advancement was retarded for so long; (2) the establishment of the fertile and sound principles of experimental method; and (3) the wide publication, with comments and criticisms through books and periodicals, of the valuable scientific conquests obtained by the genius of man. In the group of periodicals which have contributed so powerfully to bring the extensions of natural knowledge in their diverse manifestations before a wide circle of readers NATURE, the fiftieth year of which is now celebrated, has contributed very greatly. The journal must be considered an active promoter of scientific learning, and of the spirit by which the treasury of human knowledge is enriched. Associating ourselves with its jubilee feast, we send our very hearty compliments to NATURE's Editor and publishers.

Switzerland.

Société de Physique et d'Histoire Naturelle de Genève. *Le Président:* M. J. CARL. *Le Secrétaire:* M. E. JOUKOWSKY.—Les naturalistes genevois ont appris avec plaisir que le périodique NATURE fêtait prochainement le cinquantenaire de sa fondation. Ils apprécient les immenses services que ce journal a rendu à la diffusion des sciences naturelles par ses comptes rendus judicieux de l'activité des académies, par ses critiques des publications scientifiques et surtout aussi par des articles originaux dûs à la plume des savants anglais et étrangers les plus éminents. Tout en se mettant au service de la science pure, NATURE s'est toujours efforcé de tenir ses lecteurs au courant des progrès réalisés dans la technique et dans l'enseignement des sciences naturelles. Persuadés que votre journal continuera à occuper un des premiers rangs parmi les périodiques scientifiques, nous rendons hommage au travail que vous avez accompli et souhaitons à votre entreprise le meilleur succès dans l'avenir.

Société Helvétique des Sciences Naturelles. *Central President:* PROF. DR. ED. FISCHER.—I beg to offer my hearty congratulations on the fiftieth anniversary of NATURE. The journal has always in a remarkable manner understood how to present an extraordinarily complete survey of the position and development of the various branches of the natural sciences. It has also had the good fortune to number among its contributors the most distinguished naturalists and thinkers of Great Britain. To our congratulations we add the expression of our grateful recognition of the fact that the journal has repeatedly directed the attention of its readers to Swiss research work and the activity of our society. May NATURE ever succeed in awakening and retaining interest in the high importance of the natural sciences in the widest circles.

United States.

The Franklin Institute, Philadelphia. *President:* MR. WALTON CLARK. (By cable.)—The Franklin Institute extends to NATURE heartiest congratulations on the attainment of its jubilee. No journal has contributed more in the past fifty years to stimulate interest in physical and natural science. May you be as successful in the future; for a widespread knowledge of science is to-day imperative if the civilised nations are to continue to exist.

National Academy of Sciences, Washington. *Foreign Secretary:* PROF. G. E. HALE. (By cable.)—The president, Dr. Charles D. Walcott, requests me to offer his congratulations to NATURE on the occasion of its jubilee and on behalf of the Academy to express the deep appreciation felt in the United States for the work accomplished by NATURE in the advancement of research in the world. During a period of specialisation NATURE's extensive survey of the progress of research has stimulated wider vision and larger effort in spite of repeated discouragement. It has urged upon the statesmen of two generations the vital importance of science to the nation. At a time when the branches of science, no longer isolated, are uniting in common channels, and when Governments once unappreciative are recognising the bearing of research on national security and public welfare, we rejoice in NATURE's expanding influence and the higher opportunities for services opening to it in a newly ordered world.

UNIVERSITIES.

Queen's University of Belfast. *Vice-Chancellor:* REV. THOMAS HAMILTON, D.D.—Most heartily do I congratulate the Editor and proprietors of NATURE on its jubilee. The progress of science in the half-century which has passed since November 4, 1869, when the first number of NATURE appeared, has undoubtedly been more illustrious than that

of any previous fifty years (or, for that matter, any previous one hundred and fifty years) of the world's history, and there can be no question that, in that progress, NATURE has been indeed *pars magna*. All the indications, however, point to the conclusion that, splendid and memorable as has been the advancement of science in that half-century, the next fifty years will see the chariot wheels revolving with a vastly increased velocity. That being probably so, it is equally clear that the services of such a journal as NATURE will, in the future, be more needed than ever before. I congratulate, *ex imo pectore*, all concerned in its publication on the conspicuous ability with which it has been conducted, the splendid progress it has made, and the value of the work it has done since the issue of its initial number. But I also congratulate, with equal cordiality, the entire scientific world, at the commencement of another vitally important half-century, on the possession of such a very ably conducted and enlightened organ, and I fervently pray that, when the year 1969 arrives, it will find our beloved NATURE still holding on its way and, in its very old age, still bringing forth such fruit as it now yields from week to week with ceaseless regularity, acceptance, and success.

University of Birmingham. *Vice-Principal:* SIR WM. ASHLEY.—The influence of NATURE on the welfare of modern universities is matter for grateful acknowledgment. It has fostered that local generosity and enlightened opinion which led to their foundation and endowment. Through its columns there has appeared an informed and helpful criticism that has furthered university growth and development, and its records of progress in science have been of value to all graduates, and specially to those scattered in distant centres. The list of universities is not yet complete. A new age of learning has begun. New centres for promoting "humane" and scientific knowledge are arising. Meanwhile, as one of recent growth, the University of Birmingham cordially congratulates NATURE on its successful advocacy of higher learning, and sincerely hopes that its influence may continue to help those who are shaping the educational future of the Empire during the fateful years that are coming.

University of Bristol. *Vice-Chancellor:* SIR ISAMBARD OWEN, D.C.L., M.D.—I hope I may be permitted to offer my hearty congratulations to NATURE upon the attainment of its jubilee. Since its first appearance in 1869 NATURE has occupied an essential place in the scientific life of this country, and may pride itself on having attained the rare position of an indispensable publication. I shall but be voicing the feeling of the whole scientific world in wishing it a long career of continued prosperity and usefulness.

University of Cambridge. *Vice-Chancellor:* DR. P. GILES.—It must be a great satisfaction to all who admire and wish well to British learning to know that at the end of its fifty years of successful career NATURE remains as it has so long been: a most valuable medium of opinion and criticism on scientific subjects. To NATURE the man who is remote from academic centres looks for the first information on new discoveries and for a sound judgment on the publications of the scientific world. One result of the war has been an advance, rapid beyond past experience, in many fields of knowledge. Of all such advances may NATURE continue to be the herald as heretofore!

University of Durham. *Vice-Chancellor:* MR. J. S. G. PEMBERTON.—The Vice-Chancellor, on behalf of the University of Durham in general, and the Dean of the Faculty of Science, on behalf of the Science Faculty at Armstrong College in particular, send hearty congratulations to NATURE on the celebration of its jubilee. NATURE, in the past, has occupied a unique position in forming a connecting link between workers in various branches of science the world over. Many a time discussions on subjects of interest to more than one scientific section have been carried on in its columns. A notable case was when the late Lord Rayleigh in 1892, in a letter to NATURE, asked for suggestions from chemists as to the reason for the discrepancy he had found between the densities of "atmospheric" and "chemical" nitrogen. This led eventually to the successful co-operation of Lord Rayleigh and Sir William Ramsay in the discovery of "argon." Such interlinking between the sciences promises to be of even greater importance in the future.

University of Edinburgh. *Principal and Vice-Chancellor:* SIR ALFRED EWING, K.C.B., F.R.S.—My debt to NATURE extends back to the 'seventies, when we were both very young. From time to time I have been a contributor; always an interested reader. In the steady advance and diffusion of scientific knowledge during half a century NATURE has taken an honourable part, maintaining a standard which has never failed to command the respect and gratitude of serious workers. That its usefulness may long continue is the confident hope of many who in a double sense are students of Nature.

University of Glasgow. *Vice-Chancellor:* SIR DONALD MACALISTER, K.C.B.—I attended the dinner given to the Editor of NATURE five-and-twenty years ago, when Huxley and other contemporary leaders in science bore strong testimony to the great part which the journal had played in furthering the cause of natural knowledge and inquiry in this country. NATURE has, in the fateful years since then, maintained and enhanced its influence and usefulness. It has become, indeed, an indispensable factor in the development of British science. It still furnishes "solid ground" to "the mind that builds for aye." It still informs, chastens, and stimulates the scientific worker and the scientific teacher. None interested in modern higher education in particular can afford to overlook a single weekly number, except at the risk of missing a link in the evolution of the subject.

The University, Leeds. *Vice-Chancellor:* SIR MICHAEL SADLER, K.C.S.I.—We bring our tribute of gratitude and honour to those who have made the columns of NATURE during its fifty years of public service a source of indispensable help and stimulus to students of science and to those engaged in scientific education. The exacting care with which it has been

edited, the impartiality and precision of its judgments, the wide range of its information, the accuracy of its reports, have given NATURE in its own sphere unique distinction and authority. These have been used for the disinterested furtherance of investigation and for the support of the claims of science upon national attention and support.

University of Liverpool. *Vice-Chancellor:* PROF. J. G. ADAMI, F.R.S.—Looking backwards over the last quarter of a century spent overseas in Canada, I cannot but realise the heavy debt owed by me and other university teachers there to NATURE for keeping us in touch with the advances made in the various fields of science. Here, in Britain, the great dailies deal increasingly with the latest scientific developments. It is not so with the daily Press in North America. That is becoming more rather than less local and provincial. The broad survey given in NATURE fills a void in the New World that is in part bridged over in the Old. Perhaps more abundant illustrations and one or two articles each week upon the application of science and the laws of Nature to industry, added to the present contents, would widen the circle of its readers, increase its influence, and reflect the spirit of the age.

University of Manchester. *Vice-Chancellor:* SIR HENRY A. MIERS, F.R.S.—In common with all readers of NATURE, I regard its jubilee as a great event. Life would have been a different thing to us without our weekly NATURE, which has become an old friend because it has preserved its character unchanged. This is a great achievement and a testimony to the wisdom with which it was originally planned. Always a real scientific journal, it has continued to be also a popular journal in the best sense, and a great help in these days of increasing specialisation. A new and complete index to the first 100 volumes would be invaluable to all scientific workers.

University of Oxford. *Vice-Chancellor:* REV. DR. H. E. D. BLAKISTON.—The Vice-Chancellor of the University of Oxford is interested to hear that NATURE attains its jubilee in November, and offers his congratulations to the Editor. He cannot profess to be a constant reader of any scientific periodical; but when he wants clear information on any topic of scientific interest which is attracting public attention, or details of the career of any member of the University or of his own college who has obtained distinction in natural science, his first thought is to obtain the loan of a copy of the current number of NATURE.

University of Sheffield. *Chancellor:* THE MOST HON. THE MARQUESS OF CREWE, K.G.—I am happy to add my name, as Chancellor of Sheffield University and chairman of the Governors of the Imperial College, to the long list of those who are congratulating NATURE on its life of fifty years. As the nation becomes more and more conscious of its need for scientific training and the encouragement of research, it will continue to set an increasing value on NATURE, both as a record of progress and as the trusted vehicle for the expression of scientific opinions.

PERSONAL.

PROF. ISAAC BAYLEY BALFOUR, F.R.S.—NATURE, founded in the period of revolution in scientific thought following Darwin, by presentation of the work and aims and its advocacy of the claims of science, has been a powerful factor during fifty years in securing recognition by the nation of the importance of science which the lessons of the war have enforced. The world of science is proud of it. May its influence in this new period of reconstruction continue to operate forcefully, so that congratulations at its centenary may be as gratefully tendered as are those we offer now.

SIR GEORGE BEILBY, F.R.S.—I gladly record my grateful appreciation of the services rendered by NATURE to the cause of scientific culture in the best sense. The increasing tendency to specialisation by individual workers makes it more and more desirable that their touch with science in its widest aspects should be maintained with the minimum of effort on their part. This, it appears to me, will continue to be—as it has been in the past—one of the most valuable functions of NATURE.

SIR JAMES CRICHTON-BROWNE, F.R.S.—For fifty years NATURE has held the mirror up to Science and faithfully reflected her every movement. Each volume has been a record of the best brain-work of the year, ranging from the simplest observations to the most recondite abstractions. Recent issues have revealed the tremendously destructive forces that science wields, and have suggested that it has been owing to the lack of science in high places, and to the blundering that ignorance and arrogance beget, that these malign forces have been let loose on mankind. But science unperverted is beneficent, and nothing is more urgently needed at this hour than its teaching and popular exposition. Great is Science—"mightiest in the mightiest"—and NATURE is its handmaid. *Floreat Scientia! Floreat "Natura"!*

RIGHT HON. LORD BRYCE, O.M., F.R.S.—The amazing, and indeed unprecedentedly rapid, progress made during the last half-century in practically every branch of physical science, together with the increasing specialisation of most branches, has made it more and more difficult for those non-scientific persons who watch with eager curiosity the steps in that progress to follow its developments. Such persons, and especially those who occupy themselves with the study of the humanistic departments of knowledge, have long valued highly the help they receive from your journal. As one of these, I desire to congratulate the conductors of NATURE on the services it has rendered, and to express cordial wishes for its continued prosperity.

SIR FRANCIS DARWIN, F.R.S.—NATURE has for a number of years seemed to its many readers to be a beneficent natural phenomenon occurring weekly. It is wisely variegated so as to give just the type of information and criticism that we need. I warmly congratulate the Editor on its jubilee.

PROF. WYNDHAM R. DUNSTAN, C.M.G., F.R.S., DIRECTOR, IMPERIAL INSTITUTE.—I gladly take this opportunity, on the occasion of its jubilee, to congratulate NATURE on the important aid it has given to scientific work and interests, and on the position

it has achieved as an organ of scientific opinion, not only in this country, but throughout the world.

SIR F. W. DYSON, F.R.S., ASTRONOMER ROYAL.—The advancement of science owes a great deal to NATURE, which keeps men of science in constant touch with one another's work. The outstanding feature of the journal is the combination of thoroughness and trustworthiness with readability and attractiveness of form. Grateful recognition should be accorded to NATURE for its able championship of the necessity of scientific research and the claims of workers in science. It was pointed out to me recently how closely the first number published fifty years ago resembles in form and contents the current numbers. Evidently great care and thought were given to the design and scope of the journal. In offering congratulations to the Editor and publishers, I should like to express the hope that NATURE may be as useful and successful in the next fifty years.

RIGHT HON. H. A. L. FISHER, M.P., PRESIDENT OF THE BOARD OF EDUCATION.—NATURE is one of the authoritative voices of current scientific opinion. It provides the members of the scientific community with the means of publishing newly discovered facts of general interest and importance, and enables them to follow the current work and thought in their own and in other branches of science. To those dwelling on the outskirts of the scientific community, the non-professional men of science, it furnishes a valuable *résumé* of scientific news and progress, while in its columns the general public can never fail to find intelligible references to facts of interest and importance. For fifty years NATURE has most successfully performed this important function. Victory in the war could not have been achieved without the aid of science; and the vigorous pursuit of science, both pure and applied, is essential to the welfare of the nation in peace. And now we find that a general interest in science has been reawakened by its successes in the war, while our universities and colleges are crowded with students whose keenness has never been equalled, and from whom science will recruit the workers lost during the war. I trust that a new era of progress and prosperity has opened for British science, and I hope that in this era NATURE will continue to play its important part and to add to its success of the past.

M. CAMILLE FLAMMARION.—La collection de NATURE brille aux meilleurs rayons de la bibliothèque de mon observatoire. C'est une opulente et précieuse mine scientifique, admirablement composée. Dès la première page, du 4 novembre 1869, nous avons sous les yeux son vaste programme, dans un éloquent commentaire de Huxley sur les aphorismes de Goethe: "Nature! We are surrounded and embraced by her: powerless to separate ourselves from her, powerless to penetrate beyond her." Oui, la Nature nous enveloppe de ses merveilles; la Science a pour mission de l'interpréter. "Un demi-siècle passera," ajoutait Huxley, "et nous jugerons notre œuvre." Ce demi-siècle est passé. La Rédaction de cette revue peut être fière de son œuvre. J'ajouterai que NATURE est souvent en avance de plus d'un demi-siècle. Ainsi, dans ce premier volume, de 1869, on peut voir, p. 304, une carte du "railway tunnel under the Channel," p. 407, une dissertation sur la 4e dimension, et p. 14, une étude de Norman Lockyer sur la couronne solaire, le tout en avence sur nos réalisations actuelles! Félicitations et vœux pour un nouveau demi-siècle.

RIGHT HON. SIR AUCKLAND GEDDES, K.C.B., G.B.E., M.P., PRESIDENT OF THE BOARD OF TRADE.—I should like to congratulate NATURE on its long life now extending to half a century, and to wish it an even more vigorous and fruitful existence in the future. Any influence which at the present time directs the English mind to the facts of science is of service to the State. Industry, which we must now develop both in scientific economy and in volume to a level undreamed of in the days of our national pre-war wealth, needs every inspiration which science can give. NATURE is one of the possible vehicles of that inspiration, and therein lies its immediate practical importance. Of its importance to science it is unnecessary for me to speak.

DR. J. W. L. GLAISHER, F.R.S.—I was an undergraduate in my third year of residence when I saw the first number of NATURE in a shop-window, and I remember well its purchase and my interest in reading it, and how a little group of undergraduates criticised its name and discussed its contents and future. I now contemplate with admiration the hundred and three volumes and their services to science, and I am impressed by their perfect uniformity and absolute consistency of purpose. The "Notes" date from the first number, and have supplied scientific information, English and foreign, such as did not exist before, and is still unique. From the first, astronomy occupied a prominent place, and the "Astronomical Column" has been a most valuable feature from the early 'seventies. The reviews and accounts of the British Association meetings have always seemed to me especially important. The study and teaching of natural science in the University of Cambridge were in 1869 just making a feeble beginning. I read in the first number of NATURE that Mr. Bonney, of St. John's (still among us), would lecture on natural science, and that Mr. Trotter (Coutts Trotter of the "Coutts Trotter Studentship," who died in 1887) would lecture on electricity, magnetism, and botany, and the Editor added the remark that he congratulated the University on the increased desire for instruction in these subjects, but asked whether the number of men in the University competent to teach them was so small that it was found necessary to entrust electricity and botany to the same lecturer. Well, so it was. Trotter, a fellow of Trinity, had just returned from a course of study in Germany, and had induced the college to let him give these lectures. Though a mathematical man, I (perhaps induced by the paragraph in NATURE) was one of the three persons who attended Trotter's lectures on physiological botany, then an absolutely new subject in the University. The other two students soon ceased to attend, and I was the sole lecturee until Trotter considered that he had carried the subject far enough. This illustrates the vast change that fifty years have made in the University. Not many persons are now living who can remember

—and those of a later generation must find it difficult to credit—the almost complete lack of interest in natural science that existed in the University when NATURE was founded; and even in mathematics (though included in the arts) there was no encouragement—quite the reverse—to research of any kind. The progress that has been made from the stagnation of the 'sixties is enormous, and to this great expansion of thought, study, and learning NATURE has largely and worthily contributed.

SIR R. T. GLAZEBROOK, F.R.S., LATELY DIRECTOR OF THE NATIONAL PHYSICAL LABORATORY.—Those of us who have read the pages of NATURE weekly for nearly the full period of its life can realise very keenly its value and appreciate the influence it has had on the progress of natural science. It fills, and that in a most admirable manner, an important place in scientific literature; it has served as the means whereby many of the most marked advances of science have been made known to the world, and in its pages will be found the account of discoveries of the highest value to mankind. It is a privilege to send to its veteran founder the heartiest congratulations on its jubilee.

SIR DANIEL HALL, K.C.B., F.R.S., PERMANENT SECRETARY, BOARD OF AGRICULTURE.—Looking back even so far as one's earliest student days, I see NATURE as a continuous and essential part of my scientific life. It has been especially so to me, because most of my time has been spent in the country, remote from the ordinary scientific meeting grounds, and with few opportunities of learning by conversation what was going on in the scientific world. Thus one became dependent upon NATURE for information as to the changing currents of scientific opinion and for the necessary knowledge of what work was being done in other fields of science than one's own. During the period in which I have known it, the notable features of NATURE have been its catholicity, its fairness, and its dignity. It has worthily stated the case of science to the English-speaking world.

MR. W. B. HARDY, SEC. R.S.—I congratulate NATURE on its fifty years' record. Since the journal was founded science has advanced to an extent which will be realised only by the historian of the future. The advance has been made possible by intense specialisation, and the greatest service which NATURE has rendered (and indeed, in my opinion, can render) is that it has kept its readers in touch with the general progress in natural knowledge. Every movement of importance has found an expression in its pages.

PROF. W. A. HERDMAN, F.R.S., PRESIDENT-ELECT OF THE BRITISH ASSOCIATION.—NATURE is now a firmly established institution in the world of science, bringing us week by week welcome additions to knowledge, news of work in progress, helpful discussions of new views, and sound critical judgments on affairs scientific and educational. Throughout the past fifty years this journal has consistently and authoritatively upheld the freedom, dignity, and practical importance of science, and has established a splendid record of scientific progress and a fine tradition of disinterested service to the advance and diffusion of natural knowledge.

SIR ALFRED KEOGH, G.C.V.O., G.C.B., RECTOR, IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.—The attainment by NATURE of its jubilee is a notable event. Fifty years of labour in the furtherance of those principles by which, in many departments of work, unsubstantial axioms were to yield pride of place to scientific truth is no mean achievement. We may well think that the burden of the future, if different from that of the past, is no less difficult. The stimulation of inquiry, the spreading of knowledge, and the demonstration of the necessity of not merely thinking, but of thinking scientifically, are amongst the most important achievements which NATURE has successfully attempted. The interests of science are the interests of the State, and in the vista which is now opening we can all perceive a future in which the well-being of humanity is entirely dependent upon the progress of knowledge and discovery. To aid, encourage, and stimulate progress and to record advancing knowledge is henceforward, as in the past, the task of NATURE. As we look back with pride, so we may look forward with an expectant hope.

SIR JOSEPH LARMOR, M.P., F.R.S.—The early volumes of NATURE especially formed an admirable, indeed still indispensable, record of the progress of scientific discovery in our times. They were interesting without ceasing to be exact, and thereby potent to mitigate the specialisation that is inevitable for the secure and fruitful advancement of knowledge. The journalistic and discursive tendencies of the present time render such an authoritative organ, of type purely scientific, more than ever desirable.

PROF. A. LIVERSIDGE, F.R.S.—Having been a subscriber to NATURE from its first appearance, and having read every number, I wish to offer my congratulations upon its jubilee, as well as my best wishes for its continued usefulness and success.

SIR OLIVER LODGE, F.R.S.—I well remember the appearance of the first number of NATURE, when I was eighteen years old and an enthusiastic amateur student of science. The comprehensive character of the new journal was typified by an eloquent introduction by Huxley at the request of Sir Norman Lockyer. And many a man of science must have been grateful to one of the few periodicals which at a high level keeps its readers in touch with practically all branches of scientific knowledge. Over-specialisation is a real danger, and most publications necessarily cater for a limited group only, thus preventing free and easy interchange of thought across the boundary, and excluding the ordinarily educated public from participation in the current progress of science. Comprehensiveness has been the note of NATURE, and consequently it has been able to render conspicuous service. Even our rulers and literary men may occasionally find time to glance at a periodical such as this, and thereby the disastrous divorce between science and letters and public affairs is mitigated. Long may NATURE flourish, and continue to be read in all civilised countries.

PROF. W. C. MCINTOSH, F.R.S.—NATURE, with which I have been familiar from its first number onward to date, has filled an important place in the scientific literature of our country, and in a

manner which has won the confidence and elicited the help of every department of science. Moreover, its reputation is as solid abroad as at home. Its long series of volumes is indispensable in every university library and in every scientific institution or laboratory. The attainment of its jubilee, therefore, is an occasion for cordially congratulating the Editor and publishers on their long and successful labours, and for wishing them a future as fertile as the past.

SIR PHILIP MAGNUS, M.P.—As one of the early contributors to NATURE, I welcome the celebration of its jubilee as indicating its value to an ever-increasing number of readers, and the permanent place it has made for itself in the scientific world. During the past half-century the progress of science has been even more rapid than the most sanguine of its devotees could have anticipated. Towards that progress the publication of NATURE has largely contributed. It has stood in close touch with the results of the most recent scientific investigations, and one may truly say that no journal has been more ably conducted; none has been more successful in realising and satisfying the requirements of those who are actively engaged in scientific work. To the Editor of NATURE and his staff I venture to offer my sincere congratulations.

RIGHT HON. SIR HERBERT MAXWELL, BART., F.R.S.—As one of what must be but a small remnant of those who remember the birth of NATURE, let me offer humble, but cordial, tribute to the great service it has rendered to science throughout half a century. Born in a period of fierce controversy, it has proved faithful to the purpose of its sponsors, shedding a clear and steady light on the pathway of research, maintaining a lucid record of modern discovery, and stimulating the appetite for knowledge in many minds. The hand of its veteran Editor, Sir Norman Lockyer, has indeed been steady on the helm. May NATURE long retain its pre-eminence among English scientific journals!

RIGHT HON. SIR ALFRED MOND, M.P., FIRST COMMISSIONER OF WORKS.—I heartily congratulate the Editor of NATURE on the fact that his periodical, which has done so much to awaken and foster interest in science, should now be celebrating its jubilee. It has always presented the progress of scientific activities in a readable, popular, and accurately scientific manner. The readers of NATURE have been enabled to keep abreast of scientific progress, and always knew that they could rely upon the soundness of the information to be found in its pages. I hope that the general recognition of the importance of science to the progress of humanity which is now manifesting itself will extend still further in the future the valuable work and influence of this excellent journal.

PROF. JOHN PERRY, F.R.S.—I congratulate NATURE on its jubilee. I have read with interest the greater part of almost every copy issued in the fifty years, and this interest has not been confined to my own subjects, for NATURE is constantly enticing me across the borders into biology. I cannot recollect a single copy which has been much below the standard which the paper has established for itself, and I can recollect many which exceeded even that very high standard. If England were idealistic, it would bestow a decoration much higher than O.M. upon NATURE.

SIR WILLIAM J. POPE, K.B.E., F.R.S.—During the last fifty years the great truth that all human progress is dependent upon scientific knowledge has gained much more general recognition than it previously enjoyed. The life-work and the writings of our foremost men of science of the last half-century—Huxley, Tyndall, Kelvin, Roscoe, Meldola, and a host of others—have been largely instrumental in clarifying popular opinion as to the value and significance of scientific research. Throughout this period NATURE has devoted itself persistently to the task of presenting the case for science, both by systematically recording the conclusions of scientific men and by editorial elucidation and comment. Although much has been achieved, far more remains yet to be done. We look to NATURE in the future, as in the past, to impress public opinion with the necessity for giving scientific methods and results a prominent place among the activities and in the councils of the nation.

SIR DAVID PRAIN, C.M.G., C.I.E., F.R.S.—Among the services rendered by NATURE to science during the half-century which has passed since its foundation, one of the greatest will appear to the thoughtful to have been the adoption of the attitude consistently maintained in its pages towards the application of natural knowledge to everyday affairs. Launched at a dismal time when the philistinism of the nineteenth-century attitude of men of affairs towards science was only equalled by that of men of science towards affairs, NATURE had the courage to revert and adhere to that more humane perception of the seventeenth century: that the first duty of Science herself is to improve her new knowledge for use. The wider acceptance of this old doctrine which we welcome to-day NATURE may fairly claim as an abiding reward.

SIR HARRY R. REICHEL.—Hearty greetings to NATURE on its fiftieth anniversary! Science is now becoming the guiding principle of material progress, and its pursuit is justified and recommended to the public by the promise of material returns. Among those who still regard science as a branch of philosophy and worthy for its own sake, NATURE will always hold its own peculiar and honourable place. In its pages the worker whose horizon is not restricted by exclusive devotion to his own subject can follow the lines of advance along other paths of inquiry. A journal which can serve such a wide range of interests without falling into "popular" science must always occupy a unique place in the intellectual life of the nation.

PROF. J. EMERSON REYNOLDS, F.R.S.—I beg to offer my hearty congratulations to the Editor of NATURE on the jubilee of that valuable journal. NATURE has long filled so important a position in British scientific journalism, and reflected scientific progress so fully in the past, that I doubt not it will continue to do so in the future with even greater success.

PROF. W. RIPPER.—I desire to add my tribute of congratulation and thanks to the many which

you will doubtless receive on the occasion of the attainment of NATURE's first jubilee. The whole scientific community of this country is indebted to you for the great service you have rendered to science in recording with wise discrimination the progress of science and the growth of natural knowledge. Your journal is welcomed week by week as a very real friend, and we trust it may long continue to serve the great cause of science with the same distinction and ability as in the past.

SIR RONALD ROSS, K.C.B., K.C.M.G., F.R.S.—I write as editor of *Science Progress* to congratulate NATURE on attaining its jubilee. It is with warm feelings that I do so, because NATURE has been the medium of publication for almost all scientific men, whether as regards their scientific work or their personal difficulties, or even questions of organisation, emolument, and so on, for fifty years. It is pre-eminent as a scientific organ, and the editorship of it is universally recognised as being extraordinarily efficient. I myself know the difficulties, and appreciate, therefore, the way in which they are completely overcome.

PROF. ARTHUR SCHUSTER, SEC. R.S.—I desire to convey to the Editor of NATURE my sincere congratulations on the completion of the first fifty years of life of the periodical which under his guidance has attained a unique position in the scientific world. By a well-balanced combination of scientific articles, reviews, discussion by correspondence, personal notes, and general information, it soon established and continued to maintain a distinguished reputation wherever science is pursued. If continued in the same spirit of liberal thought and impartial criticism, NATURE may look forward to an equally prosperous future.

DR. D. H. SCOTT, F.R.S.—The fifty years of NATURE's brilliant career have seen great developments in botany, as in every other science. It is true that the previous half-century, which witnessed the birth of the cell theory and the acceptance of evolution, was a greater era; it was then that scientific botany, as part of biology, was created; the succeeding period has been one of vigorous and manifold growth. When NATURE started Darwinism had already won its first triumphs; it maintained and strengthened its position down to the end of the century, and then came a change. The rediscovery of Mendel's work in plant-breeding established the new science of genetics and transformed current ideas of evolution. Another new science, cytology, the intimate study of the cell, and especially of the nucleus, arose, to work hand-in-hand with genetics, revealing the nature of fertilisation and, in a certain degree, the mechanism of segregation. These are matters of fundamental significance, common to both the biological sciences. In the same field, but within the stricter limits of botany, we have the discovery of the spermatozoids of the maidenhair-tree and the Cycads, linking these primitive seed-plants with the Cryptogams, and through them with the animal kingdom, and of the strange phenomenon of double fertilisation in the higher flowering plants. Other new developments are the growth of a comparative anatomy of plants, now extended to the oldest fossil remains, and the advent of ecology, or physiology in the field. Of all this and much more a record will be found in the long series of the volumes of NATURE.

SIR AUBREY STRAHAN, K.B.E., F.R.S., DIRECTOR OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN.—I am glad to avail myself of the opportunity of sending my congratulations on the attainment by NATURE of its jubilee. The high standard aimed at in the earliest issue has been well maintained, and NATURE has now for half a century been our leading weekly journal on pure science. As regards geological literature, apart from the valuable original articles which appear in its columns, its reviews especially supply a want which is not provided for elsewhere. I venture to express the hope, which I believe will be shared by all scientific men, that NATURE may continue to fulfil its high functions for many years to come.

SIR J. J. H. TEALL, F.R.S., LATELY DIRECTOR OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN.—That NATURE has rendered great services to science in general and to all its branches is universally admitted. I have followed its development from the time of its first appearance until now with interest, sympathy, and admiration; and it is with a profound feeling of gratitude that I offer my hearty congratulations on the celebration of the jubilee of the great journal which has been edited with so much tact and ability for fifty years.

PROF. H. H. TURNER, F.R.S.—The benefits of such work as yours are absorbed into the scientific system so naturally that, for the most part, they excite no attention. All the more is it, therefore, appropriate that at certain epochs notice should be expressly directed towards them and an attempt made to integrate what we have been quietly receiving for so many years in order that we may be truly thankful. It gives me great pleasure to be one of those invited to put our thanks into words.

DR. HENRY DE VARIGNY, SCIENTIFIC EDITOR OF THE "JOURNAL DES DÉBATS."—As an old and very faithful reader who has never failed throughout forty years to read NATURE, I beg to send my thanks to the Editor, contributors, and publishers for the pleasure and information they have given me. NATURE has been, and remains, *the* organ of British scientific thought and progress. All the work of Britain's magnificent team of naturalists, astronomers, physicists, chemists, biologists, etc., has been made known to the world by NATURE. Sincere thanks are due for the good work done in the interest of scientific progress, and cordial congratulations to the Editor on this anniversary. May both he and NATURE live long to pursue their task, one which becomes more useful and essential than ever before to culture, *haud teutonico sed humano sensu*; and may we all, on both sides of the Channel, maintain that cordial understanding so firmly maintained through the ordeal of blood and fire for the freedom of civilisation.

SIR H. TRUEMAN WOOD.—I have been a regular reader of NATURE since 1870—for forty-nine out of its fifty years of existence. There can-

not be very many now left who can say as much, so I hope I may be allowed to add my voice to the chorus of congratulation which I am sure will greet the completion of its first half-century. Others may be better qualified to testify to the value of its services to various branches of science, but nobody can be more appreciative of the help it has given to the progress of science generally, especially in this country, which is fortunate in possessing what is admittedly the leading scientific newspaper in the world. The thanks of all associated with scientific matters are due alike to its eminent founder, still happily amongst us, and to the publishers who co-operated with him in what at the time can scarcely have been regarded as a very promising speculation.

DR. HENRY WOODWARD, F.R.S.—Having been present at a dinner at the Garrick Club in 1869 to inaugurate the birth of NATURE, now in its fiftieth year, I feel proud to be permitted to offer by hearty congratulations to the Editor and the publishers upon this memorable occasion of its jubilee. It is no small undertaking to have produced more than 2600 weekly numbers of a journal embracing every branch of natural knowledge during half a century. Long may NATURE flourish, and long may the founder be spared to see its prosperity and, with the eminent firm of Macmillan, enjoy its cosmopolitan honours and high scientific reputation.

NOTES.

THE KING has been pleased to approve of the following awards this year by the president and council of the Royal Society:—Royal medal to Prof. J. B. Farmer for his notable work on plant and animal cytology, and Royal medal to Mr. J. H. Jeans for his researches in applied mathematics. The following awards have also been made by the president and council:—Copley medal to Prof. W. M. Bayliss for his contributions to general physiology and to biophysics; Davy medal to Prof. P. F. Frankland for his distinguished work in chemistry, especially that on optical activity and on fermentation; Sylvester medal to Major P. A. MacMahon for his researches in pure mathematics, especially in connection with the partition of numbers and analysis; and Hughes medal to Dr. C. Chree for his researches on terrestrial magnetism. The following is a list of those recommended by the president and council of the Royal Society for election to the council at the anniversary meeting on December 1:—*President:* Sir J. J. Thomson, O.M. *Treasurer:* Sir David Prain, C.M.G. *Secretaries:* Mr. W. B. Hardy and Mr. J. H. Jeans. *Foreign Secretary:* Prof. W. A. Herdman. *Other Members of the Council:* Mr. J. Barcroft, Mr. C. V. Boys, Sir J. J. Dobbie, Sir F. Dyson, Prof. J. B. Farmer, Sir W. M. Fletcher, K.B.E., Prof. F. W. Gamble, Sir R. T. Glazebrook, Prof. J. W. Gregory, Dr. A. C. Haddon, Sir R. A. Hadfield, Bart., Sir A. B. Kempe, Sir W. J. Pope, K.B.E., Dr. S. H. C. Martin, Prof. A. Schuster, and Prof. W. P. Wynne.

THE President of the French Republic, accompanied by Mme. Poincaré, received a cordial welcome upon his arrival in London on Monday, on a visit to the King and Queen. British men of science would wish to convey to President Poincaré the expression of their high regard for the influence France has always exerted in the cause of science and civilisation in Europe, and of fraternal greetings to the eminent leaders in intellectual activity who are preserving this great heritage. A banquet in honour of President and Mme. Poincaré was given by the King and Queen at Buckingham Palace on Monday evening. On Tuesday the President, accompanied by Mme. Poincaré, visited the City and were presented with an address by the Lord Mayor. To-day the President is to be installed as Lord Rector of Glasgow University, and, with Mme. Poincaré, will be entertained at luncheon at the University, after which he is to be presented with the freedom of the city.

A CORRESPONDENT informs us that the Village Club at Wimbledon, wherein, as Sir Norman Lockyer explained in our jubilee number, the idea of NATURE was born, was founded by Dr. Joseph Toynbee (father of Arnold Toynbee), and one of his intentions was to have a local museum in the building. Such a museum is now there, brought together by the more recently established John Evelyn Club for Wimbledon. The Village Club premises were occupied by the military during the war, but the collections have now been replaced and are again open to the public. They include prints, pictures, maps, and a photographic survey, as well as many antiquities, bygones, and natural history specimens, all connected with the locality. It is hoped that the portrait of Sir Norman Lockyer will soon adorn the walls of the museum.

SIR E. RAY LANKESTER has just completed fifty years' editorship of the *Quarterly Journal of Microscopical Science*, and the current issue of that well-known periodical (vol. lxiv., part 1) contains a brief summary by Prof. G. C. Bourne of the contents of the journal for the last half-century, demonstrating very clearly the important part that it has played in the development of modern biological science. We offer our hearty congratulations to Sir Ray Lankester on this notable occasion, and hope that many more volumes may appear under his distinguished editorship.

IN reply to a question by Sir Philip Magnus, Mr. Bonar Law has announced that the Commissioners to be appointed under the Forestry Acts are as follows:—Lord Lovat (chairman), Director of Forestry, B.E.F., France, and member of Forestry Reconstruction Sub-Committee and of the Interim Forest Authority; Mr. F. D. Acland, M.P., chairman of the Home-grown Timber Committee, chairman of the Forestry Reconstruction Sub-Committee, and chairman of the Interim Forest Authority; Lord Clinton, formerly president of the Royal English Arboricultural Society and member of the Interim Forest Authority; Mr. L. Forestier-Walker, M.P.; Sir John Stirling-Maxwell (hon. secretary), formerly president of the Royal Scottish Arboricultural Society and member of the Forestry Reconstruction Sub-Committee; Mr. T. B. Ponsonby, member of the Interim Forest Authority; Mr. R. L. Robinson, member of the Interim Forest Authority, secretary of the Forestry Reconstruction Sub-Committee, and formerly head of the Joint Forestry Branches of the Board of Agriculture and Office of Woods; and Col. W. T. Steuart-Fotheringham, member of the Interim Forest Authority.

AFTER a successful military campaign the House of Commons has frequently voted large sums of money from public funds to the commanders under whose guidance the conquest was won. National recognition of a like kind was given to Jenner by a grant of 10,000*l.* made by the House in 1802, and by a further grant of 20,000*l.* five years later, the intervening period having strengthened the opinion as to the efficacy of vaccination and its great benefits to the nation at large. Sir Ronald Ross has long

urged that this principle should be commonly followed in connection with great discoveries by which numerous human lives are saved, as it is as the result of military conquests. In the case of a medical man devotion to research means the sacrifice of private practice, and when the result of his work is to the great advantage of the human race at large, or the nation in particular, much can be said in favour of just compensation to him. To further this reasonable claim for awards for medical discovery, a joint committee of the British Medical Association and the British Science Guild has just been formed. Sir Ronald Ross entertained the members of the committee to luncheon on November 4, and among those present were Prof. W. M. Bayliss, Sir Alfred Keogh, G.C.B., Dr. R. T. Leiper, Prof. B. Moore, Col. Nathan Raw, M.P., and Dr. W. Somerville. At a meeting held on the same day it was decided that each of the members of the committee should collect information regarding medical research work and discovery already carried out which he considers worthy of recompense by the Government or other bodies, and Sir Ronald Ross undertook to collate and edit the information in a report to the committee for further action.

IN June, 1917, the Fuel Research Board was asked by the Board of Trade and other Government Departments concerned to advise as to the most suitable composition and quality of gas. In January last the Board made its report, and this has since been the basis of negotiations between representatives of the Board of Trade, gas companies, and local authorities. An agreement has now been reached, and from a recent statement by Sir A. Geddes, in reply to a question in the House of Commons, a Bill will shortly be introduced to give effect to the recommendations of the Fuel Research Board as modified by the agreement now arrived at. The gas consumer will be charged for the potential thermal units supplied to him, the unit to be 100,000 British thermal units. The gas companies are to declare the calorific value of the gas they propose to supply, no fixed standard being laid down by Parliament. The British thermal units supplied are to be calculated by multiplying the number of cubic feet registered by the consumer's meter by the *declared* gross calorific value of the gas per cubic foot. (The original proposal of the Fuel Research Board is modified by the introduction of the word "declared.") The calorific value of the gas is to be continuously measured and recorded. As regards the proportions of inert constituents allowable, the Board's original proposal was a maximum of 12 per cent., the gas companies claiming to be freed from any restrictions in this direction. The compromise now agreed upon states that the amount of inert constituents shall not exceed 20 per cent. for two years, 18 per cent. for the next two years, and 15 per cent. afterwards. The gas undertaking is to adjust, and if need be to replace gratis, the burners in consumers' appliances so that the gas delivered can be burned in these appliances with safety and efficiency. It will no doubt require some time for the consumer to become accustomed to these changes and to be educated up to grasp the meaning of the new unit, but, owing to the time required to make the new instruments and to adjust the consumer's appliances, it will probably be three or four years after the passing of the new Bill before gas is supplied over the whole country under the new conditions.

PROF. A. FOWLER, professor of astrophysics, Royal College of Science, South Kensington, has been awarded a gold medal by the National Academy of Sciences, Washington, in recognition of his eminent contributions to astronomical science.

PROF. A. W. CROSSLEY, professor of chemistry in the University of London (King's College), has been appointed director of research to the British Cotton Industry Research Association.

NOTICE is given that applications for grants from the Chemical Society Research Fund, made upon forms obtainable from the assistant secretary of the society, must be received on or before Monday, December 1 next.

THE Geological Survey of Great Britain and Museum of Practical Geology, Jermyn Street, S.W.1, have been transferred for administrative purposes from the Board of Education to the Department of Scientific and Industrial Research as from November 1. Correspondence with reference to the work of the Survey should be addressed as heretofore to the Director of the Survey and Museum, Jermyn Street, S.W.1.

AT a general meeting of the members of the Royal Institution, held on November 3, the special thanks of the members were returned to Mr. Richard Pearce for his donation of 100*l.* to the fund for the promotion of experimental research at low temperatures; to Mr. Robert Mond for his gift of laboratory material; and to Sir Humphry Davy Rolleston for his gift of a drawing of Sir Humphry Davy's birthplace and a water-colour of his statue in the Market Place, Penzance.

AT University College, London, on Tuesday, tablets in memory of Lord Lister were unveiled before a large and distinguished assembly. The Duke of Bedford, who opened the proceedings, said that every civilised community realised the debt of gratitude it owed to Lord Lister. Sir George Makins, president of the Royal College of Surgeons, unveiled the tablet to be erected in University College Hospital, and Sir Joseph Thomson, president of the Royal Society, that to be erected in University College.

AT the anniversary meeting of the Mineralogical Society, held on November 4, the following officers and members of council were elected:—*President:* Sir William P. Beale, Bart. *Vice-Presidents:* Prof. H. L. Bowman and Mr. A. Hutchinson. *Treasurer:* Dr. J. W. Evans. *General Secretary:* Dr. G. T. Prior. *Foreign Secretary:* Prof. W. W. Watts. *Editor of the Journal:* Mr. L. J. Spencer. *Ordinary Members of Council:* Mr. H. F. Collins, Mr. J. P. De Castro, Prof. H. Hilton, Mr. Arthur Russell, Dr. A. Holmes, Miss M. W. Porter, Mr. R. H. Rastall, Sir J. J. H. Teall, Mr. A. F. Hallimond, Dr. F. H. Hatch, Mr. J. A. Howe, and Mr. W. Campbell Smith.

THE meeting of the Physical Society of London on November 28 (at 5 p.m. in the Imperial College of Science, South Kensington) is to be devoted to a discussion of the subject of lubrication. The physical qualities of a good lubricant have for long eluded capture, and it is expected that the discussion will at least furnish a step towards the solution of the problem, and at the same time create a wider interest in the subject. Amongst those who will take part are the following:—L. Archbutt, R. Mountford Deeley, W. B. Hardy, secretary R.S., F. W. Lanchester, H. M. Martin, Principal Skinner, and Dr. T. E. Stanton. The meeting is an open one, and all who are interested in the subject are invited to attend.

DR. JOHN BROWNLEE has investigated statistically the periodicity of influenza epidemics. Considering specially the years 1889–96, he finds that the interval

between the epidemics is thirty-three weeks, there being a missed epidemic when an epidemic is due in the autumn (*Lancet*, November 8, p. 856). With regard to the recent epidemics, from July 13, 1918, to March 1, 1919, the maximum points are separated by thirty-three weeks; from March 1 to October 1, 1919, is also thirty-three weeks. An epidemic is therefore due, but falls at an unsuitable season, and should therefore be small, and so far this is the case. On the same sequence the next epidemic should occur in January or February of the new year.

LORD MILNER, Secretary of State for the Colonies, has appointed a Committee to consider the position of the medical services of the various Colonies and Dependencies, with the view of maintaining and increasing the supply of candidates and of securing contentment within the service; and to consider whether the principle of assimilating the medical service of neighbouring Colonies may usefully be extended, and, if so, how far and by what means. The members of the Committee are:—Sir Walter Egerton, K.C.M.G. (chairman), Lt.-Col. Sir Harry Verney, Bart., Sir Humphry D. Rolleston, K.C.B., Sir W. B. Leishman, K.C.M.G., Lt.-Col. Sir James Kingston Fowler, K.C.V.O., Mr. T. Hood, Mr. A. Fiddian, and Mr. J. E. W. Flood (secretary).

AMONG the old mathematical worthies who are buried in the churches of the City of London is Nathaniel Torporley, who was interred in the church of St. Alphage, London Wall, now being demolished. Torporley, of whom there is a sketch in the Dictionary of National Biography, was born in 1564, the same year as Shakespeare. From the Shrewsbury Grammar School he passed to Oxford, graduating in 1584 from Christ Church and taking Holy Orders. It is said that for some years he resided in France and was amanuensis to François Vieta. After his return to England he became one of the pensioners of Henry Percy, the ninth Earl of Northumberland, and, like his contemporaries Harriott, Dee, Warner, and Allen, spent a part of his life at Sion College. Among his writings was one containing a rule for solving spherical triangles. Torporley died at Sion College, and was buried on April 17, 1632. The Church of St. Alphage was, we understand, destroyed in the Fire of London, 1666, but was afterwards rebuilt.

THE activities of the Royal Photographic Society naturally divide themselves into two sections, namely, the pictorial and generally illustrative and the scientific and technical. We are very pleased to see that a few of the more energetic members are taking the latter division in hand in order to develop it by extending its scope and encouraging scientific work. The "Scientific and Technical Group" consists already of 137 members of the society, and it is hoped that this number will soon be largely augmented. The members of the group pay a small additional subscription, the disposal of this fund being exclusively under the control of the administrative committee of the group. It is hoped to be able to distribute among the members abstracts or translations of scientific communications made to other societies or publications, as well as to arrange for scientific and technical lectures and papers. The Royal Photographic Society has always been the most important photographic centre in this country, and it is to be hoped that this new arrangement will be energetically pursued, and that it will lead to a greatly increased interest being taken in the science of photography.

THE annual council meeting of the National Union of Scientific Workers was held on Saturday, November 8, at the Imperial College Union, South Kensington, and was attended by delegates from nine branches. The chair was taken by the retiring president, Dr. O. L. Brady, and the chief business was the adoption of the annual report and of the rules, and the election of officers and executive committee for the ensuing year. Dr. J. W. Evans was elected president, Dr. Norman Campbell treasurer, and Mr. Eric Sinkinson secretary. At the dinner which followed, Dr. Evans, who presided, expressed the hope that the union, in company with such other bodies as the British Association and the British Science Guild, would do great things for science. Sir Ronald Ross, replying to the toast of "The Guests," thought there were three points for which the union might press:—(1) Better payment for newly qualified men, including the modification of the present system of research assistantships; (2) pensions on a transferable basis for staffs of universities and other institutions; and (3) payment for advice given to Government and municipal bodies, which frequently did not even give travelling allowances. The union should also press for public recognition and awards for inventions.

IN an able and very valuable summary of the mammals in the Melbourne Zoological Park, Dr. W. H. D. Le Souef, the director, contrives to give a lively description of all the more important indigenous mammals of Australia. As might have been expected, he adds some very interesting facts to what is known of the life-histories of these animals. Throughout he is constantly insisting on the need for legislation to stay the work of the exterminator. Over vast tracts of country some species have become absolutely wiped out. It is not a little disconcerting indeed to learn that the skins of wallabies and kangaroos are exported by the hundred thousand, for this means that vested interests are sure to beget strenuous opposition to the proposal which has been made to frame protective measures to secure the survival of at least a remnant of this remarkable fauna. But we trust this legislation will be speedily effected, or it will come too late. An additional toll upon this fauna is levied by the dogs, foxes, and cats which have been introduced by settlers, and in many cases have become feral. This memoir, which is illustrated by a number of very beautiful photographs, is issued by the New York Zoological Society.

THE *Journal of Indian Botany*, the first number of which appeared in September, has been started under the editorship of Mr. P. F. Fyson, of the Presidency College, Madras, to provide a means of publishing botanical work done in India which would not naturally find a home in the existing botanical journals of that country. In addition to original papers it is proposed to publish abstracts and reviews of papers which appear in other journals. The editor appeals for help to Indian botanists to make the journal, which will appear monthly, a success. The present issue contains a short paper by L. A. Kenoyer on the dimorphic female flower of *Acalypha indica*, a common tropical weed belonging to the family Euphorbiaceæ, which grows over most of India as a weed on waste ground. The lateral female flowers resemble those of Ricinus (Castor Oil) and the Euphorbiaceæ generally, but the terminal flower of the spike has one in place of three carpels, and develops one seed, which also differs slightly in size and structure from the normal seed. S. L. Ghose gives a systematic account of the Myxophyceæ, or blue-green algæ of Lahore, which occur throughout the year in drains and watercourses, artificial tanks, ditches, and on moist ground and tree-trunks. The study of this group has hitherto been neglected in

India. The author describes about twenty species which occur commonly, and others are occasionally met with. L. J. Sedgwick discusses the distinguishing features of some closely allied species of the genus Alysicarpus (Leguminosæ); and P. F. Fyson and M. Balasubrahmanyam describe the growth and root-structure of the strand-grass, *Spinifex squarrosus*, as a factor in the marine strand vegetation of Madras.

THE recent work of the French in Morocco under the direction of Gen. Lyautey is described in detail by M. A. de Tarde in a well-illustrated article in the *Geographical Review* for July (vol. viii., No. 1). Gen. Lyautey has not stayed his hand during the war, but has continued a policy of reconstruction on a bold scale, building roads, railways, and harbours, improving agriculture, and multiplying schools, hospitals, and administrative buildings. The growth of European population in the larger town is not to be allowed to crush the native town, nor is the European quarter to form part of the old town. All European towns are to be separated from native towns by a strip of ground, on which no building is allowed. The task of planning the European towns has been entrusted to competent architects and engineers under the direction of M. Prost, who recently drew up plans for the extension of Antwerp. The plans for Casablanca, the chief port, Rabat, Fez, Marrakesh, and Meknes are now complete.

AT the first meeting of the new session of the Institution of Petroleum Technologists, held on October 21, a paper was read by Mr. A. Philip on "Some Laboratory Tests on Mineral Oils." The author referred at length to the imminent need for the standardisation of tests and methods in petroleum analysis, and considered that it would not be feasible to prepare and circulate standard material of known composition. He therefore urged the very detailed description of procedure, so that it would be possible for a reasonably accurate repetition of results to be obtained from chemists working in different laboratories. The sampling of oils was described minutely as practised at Portsmouth, and great emphasis was laid on this all-important preliminary operation. The author then dealt with the distillation of crude oils, and described a novel experimental still of very considerable merit and ingenuity, designed to minimise the time occupied in the determination of the light oils and water-content of a given material. Tabular matter illustrated the application of the method, and results were given of the analysis of the Hardstoft oil. Methods of determining the vapour pressure of petrol, calorific value, moisture, and flash-point were criticised, and the procedure adopted in the lecturer's laboratory was detailed. It was shown that the flash-point of a fuel oil was liable to an experimental error of nearly 5 per cent., whilst if the oil was wet the discrepancies were very much more serious. In consequence a considerable tolerance should be allowed in specifications. A discussion followed, in which Sir Thomas Holland, Prof. Brame, and Dr. Ormandy made reference to the subject of standardisation, whilst Dr. Dunstan, Mr. Mitchell, and Mr. Lomax brought forward criticisms of the various methods detailed in the paper.

THE *Engineer* for October 24 contains a description of the recently completed undertaking for the supply of water to Greater Winnipeg. The quantity rendered available amounts to 85,000,000 gallons per day, which should suffice for the needs of the city for some time to come, as the present number of inhabitants is only some quarter of a million, and the consumption 44 gallons per head per day. The water is obtained from Shoal Lake, with an area of 107 square miles, and a catchment basin of 360 square miles, which is connected with the larger expanse of 1400 square miles known as the Lake of the Woods. It is described as soft and excellent in quality; the chlorine content is three parts per million. The distance conveyed is 96½ miles. Of this 77½ miles is cut-and-cover work, with culverts varying from 10 ft. 9 in. by 9 ft. to 6 ft. 5 in. by 5 ft. 5 in. There are 7 miles of river siphons and 9½ miles of reinforced concrete pressure pipe. The distributing mains in the city of Winnipeg consist of 2⅛ miles of 48-in. concrete pipe. The work was commenced in 1913, and estimated to cost just above 2,600,000*l*.

MR. F. W. CLIFFORD, librarian to the Chemical Society, contributes to the *Library Association Record* for August an article on "The Library of the Chemical Society: A Record of a Recent Attempt at Co-operation." The Chemical Society has always aimed at including in its library every book and periodical that might help its fellows in their work. During the war this library has been of the greatest assistance to the nation, since it was found to contain most of the important works of foreign origin which Government Departments and manufacturers wished to consult. This increased use of the books impressed upon the library committee the importance of further extension in the technical direction. The council therefore invited a number of kindred societies to co-operate with it in extending the technical equipment of the library by appointing representatives on the library committee and by giving financial assistance for the purchase of books. The members of the societies thus co-operating are able to use the library on the same terms as fellows. The invitation has been accepted by the Association of British Chemical Manufacturers, the Biochemical Society, the Faraday Society, the Institute of Chemistry, the Society of Chemical Industry, the Society of Dyers and Colourists, and the Society of Public Analysts. This form of co-operation might perhaps be adopted with advantage by other libraries devoted to special branches of knowledge.

Messrs. George Bell and Sons, Ltd., announce:—"The Physiology of Vision: With Special Reference to Colour-blindness," Dr. F. W. Edridge-Green; "Practical Biological Chemistry," Bertrand and Thomas, translated by Capt. H. A. Colwell; "An Introduction to the Study of Vector Analysis," Prof. C. E. Weatherburn; "Nomography," Dr. S. Brodetsky; "Differential Equations and their Applications," Dr. H. Pioggio; and "Intermediate Chemistry," Prof. A. Smith. The same publishers have in preparation "Recent Investigations in Fluorescence and Related Phenomena," Prof. R. W. Wood; "A Text-book of Zoology," Prof. C. H. O'Donoghue; and "Physics: An Intermediate Course," Dr. A. O. Rankine. *Messrs. J. M. Dent and Sons, Ltd.*, are about to publish a portfolio of twenty-four coloured "Nature Studies" by E. J. Detmold. The issue will be limited to 500 sets, each of which will be numbered and accompanied by a certificate signed by the artist. *Messrs. Longmans and Co.* have in the press for appearance next year vol. i. of the treatise on "Higher Inorganic and Theoretical Chemistry," in six volumes, upon which Dr. J. W. Mellor has been working for the past twelve years. They also announce "A Manual of Practical Anatomy," 3 vols. (vol. i., The Extremities; vol. ii., The Head and Neck; and vol. iii., The Thorax and Abdomen), Prof. T. Walmsley; "Structural Steelwork," E. G. Beck; "A First-Year Physics for Junior Technical Schools," G. W. Farmer; and "Life in Early Britain: A Survey of the Social and Economic Development of

the People of England from Earliest Times to the Norman Conquest," N. Ault. The new list of *Messrs. George Routledge and Sons, Ltd., and Kegan Paul and Co., Ltd.*, includes:—"The Social Maladies: Tuberculosis, Syphilis, Alcoholism, Sterility," Dr. J. Héricourt, translated, with a final chapter, by B. Miall; "Agriculture and the Farming Business," O. H. Benson and G. H. Betts; "Wonders of Insect Life," J. H. Crabtree; "Germination," A. E. Baines; and "Bakery Machinery," A. W. Mathys; "The Clay-working Industries," A. B. Searle; "Direct-current Dynamos and Motors," Prof. W. B. Griffith; "Electric Cooking and Heating," W. A. Gillott; "Engineering Instruments and Meters," E. A. Griffiths; "Manufacture and Installation of Electric Cables," C. J. Beaver; "Reproduction and Utilisation of Sound," H. O. Merriman; "The Turbo-Alternator," Dr. S. F. Barclay; and "The Utilisation of Natural Powers," E. L. Burne (in Routledge's Industrial Supremacy Books).

ARRANGEMENTS have been completed for the amalgamation of the business carried on by Mr. Robt. W. Paul at New Southgate, London, with the Cambridge Scientific Instrument Co., Ltd. Mr. Paul will join the board of directors, and the manufacture of instruments will be continued both at Cambridge and at New Southgate. On January 1, 1920, the name of the company will be altered to the Cambridge and Paul Instrument Co., Ltd., and as soon as possible the head office and showrooms will be transferred to London.

THE South-Eastern Union of Scientific Societies was established in 1896, and includes more than seventy affiliated societies. A correspondent writes to point out that the union was omitted from the list given last week. The list was not intended, however, to include unions or federations of societies, but rather individual societies which meet periodically throughout the year.

OUR ASTRONOMICAL COLUMN.

THE LEONID METEORS.—Though no special display of these objects is to be expected this year, the sky should be vigilantly watched on the nights from November 13 to 16, and particularly during the hours following midnight. The moon will be at the last quarter on November 14, being visible in the morning hours, but her light will be feeble and cannot materially interfere with the aspect of the shower. The radiant point in Leo does not rise until about 10.20 p.m. If any of the usual bright, streaking meteors are observed from this system, their apparent paths amongst the stars should be carefully recorded. There is no doubt, from the observations obtained in past years, that the stream of November Leonids is continuous in all sections of the orbit, and that there are considerable differences in the apparent strength of the shower witnessed from year to year. The maximum may be expected on the morning of November 15 or 16.

The shower of meteors connected with Biela's comet is due to return a few nights later than the Leonids, and, as the moon will then have waned to the crescent shape, observations may be favourably made should the atmosphere be suitable and free from the clouds and fogs so common to our climate at this season of the year.

THE GROUP OF HELIUM STARS IN ORION.—There has for long been a natural curiosity to find the distance of the great nebula in Orion. The problem became more hopeful when it was found that the group of helium stars was probably connected with the nebula, as appeared both by their configuration and by identity of radial motion (about +22 km./sec.). Dr. Bergstrand, of Upsala, has published (Nova Acta Reg. Soc. Scient. Upsal, ser. iv., vol. v., No. 2) an attempt to find this distance. First, he made a careful re-examination of proper motions in order to find the rate of closing in on δ Orionis, owing to increasing distance from us; he found for the parallax 0·0044″, with probable error 0·0049″. The second method was based on the assumption that the scattering of individual proper motions is comparable with that of the radial velocities; he thus obtained 0·0076″, with probable error less than 0·002″. It will be seen that the two determinations are of the same order of magnitude, and are also comparable with some other values; thus Dr. Charlier, in his memoir on the B stars, gave figures for the Orion group of which the mean is 0·0118″, and Prof. Kapteyn by another method found 0·0058″. Also four of the stars are binaries, and the mean of their hypothetical parallaxes, as given by Messrs. Hertzsprung and Stebbins, is 0·0078″.

From the large area that the group covers in the sky there is reason to expect a corresponding range in the individual distances. Hence we may look on the various determinations as satisfactorily accordant, and conclude that in putting the distance of the nebula as 400 light-years we are not very far from the truth.

THE SECULAR ACCELERATION OF THE MOON.—In a recent paper Mr. Nevill claimed to have shown that the observations of the last three centuries prove that the acceleration does not differ from its theoretical value. Prof. E. W. Brown, in the Proceedings of the Royal Society (Series A, vol. xcvi.), shows that, by making suitable changes in initial longitude and mean motion, a change as great as 5·4″ in the acceleration will make changes in the longitude that are less than 1·6″ for the whole interval between 1620 and 1950. Quantities so small as this cannot be evaluated from the observations, so long as the large inequality with period of the order of three centuries remains unexplained by theory. Hence, apparently, the ancient eclipses, unsatisfactory as the records of them are, supply the only material available for determination of the acceleration.

THE GLASS RESEARCH ASSOCIATION.

IT is now widely known that among the industries which have been profoundly influenced by the war the glass and glassware industry of the United Kingdom occupies a foremost place. Not only have the pre-war products of this industry, as they existed in this country before the war, been found essential for a wide range of national purposes during war-time, but the necessity has also been forcibly realised of creating certain special sections of this industry, previously non-existent in the country, to supply glass and glassware, glass instruments, and glass apparatus directly necessary for the prosecution of the war, as well as similar articles equally vital as being indispensable for the efficient operation of other industries. The importance of the glass industry to the economic life of the nation is to be measured largely by its effect upon, and indispensability to, other industries. This has been fully recognised by the Government in the inclusion of scientific glassware and illuminating glassware, as well as optical glass, in the schedule of unstable "key" industries.

But the revolutionising effect of the war upon the glass industry is not alone manifest in the creation of these "key" sections which previously were monopolised by Germany and Austria, whose glass manufacturers had attained great strength and reputation,

and certainly dominated the markets of the world, or even in the resuscitation of other sections (*e.g.* the so-called "flint" glass sections) of the industry, which, though long established in this country, were rapidly declining as the result of unfair foreign competition. The feature even more significant than either of these, and the ground of the future hope that a stable and prosperous British glass industry will be firmly established, is the shedding of the old spirit of isolation and exclusiveness which possessed the manufacturers of this country. Invariably in each works there existed a policy of secrecy, together with an unwarranted satisfaction with old-fashioned rule-of-thumb manufacturing ideas and an absence of scientific method. This inevitably resulted in inability to organise for production upon progressive modern lines. During the war there has been a wonderful awakening to the new possibilities of glass production in this country, and there is now happily evidenced among the manufacturers a new spirit of co-operation combined with an enthusiasm for investigation and research, and a desire to adopt new methods and equipment involving the scientific control of manufacturing operations.

The establishment of the Glass Research Association, which after nearly twelve months' spade-work by an earnest provisional committee was launched on its career on October 14 at the first general meeting held at the Institute of Chemistry, when the first council of the association was elected, well illustrates the changed aspect which the industry has assumed. This association has been formed on the lines approved by the Department of Scientific and Industrial Research for the encouragement of research. During the next five years the association will expend at least 100,000*l.* upon investigations into the many problems of glass and glassware manufacture.

There is a vast and difficult field to cover, as will appear from the consideration of the following groups of main problems to be attacked:—Chemical and physical properties of glasses; fuels, refractories, furnaces, treatment of glass-making materials, glass-founding, temperature measurement and control; glassware-forming operations (hand and mechanical), glassware-making machinery; annealing, lamp-blown work, and other finishing operations; design, layout, and equipment of glass factories; and scientific methods of storing, packing, and transit. These are but the general problems. When they are considered in relation to the enormous varieties of types of glass articles, from common bottles, food and beverage containers, chemical and medical bottles, on one hand, to the elaborate products of the lamp-blown glassware bench-worker (*e.g.* condensers, gas-analysis apparatus, thermometers, artificial eyes, X-ray tubes, syringes, etc.) on the other; from window-glass and plate-glass to beakers, flasks, and accurately calibrated and graduated glassware; from tumblers and the numerous domestic and fancy articles of glassware in common use to electric lamps, miners'-lamp glasses, and a host of articles essential for illuminating purposes; and, in addition, the varieties of special glasses required for scientific instruments, for decorative purposes, for machinery, and for building, it is easy to realise that the problems are not lacking in number, variety, or fascination.

To consider only one problem for a moment: the manufacture of glass tubing. All scientific workers understand the essential importance of being able to obtain varieties of glass tubing having definite chemical and physical properties, and at the same time satisfying stipulated degrees of dimensional accuracy within narrow limits. Few realise the enormous difficulties involved in the production of such tubing, the wastage caused by the careful selection necessary to obtain satisfactory quality, and how much depends upon the high degree of individual skill in the worker engaged in glass tube-drawing. The Glass Research Association will not rest satisfied until, by securing the concentration of engineering genius upon this problem, glass tubing can be turned out with dimensional accuracy comparable with that secured in producing tubing of brass or other metals, and at the same time possessing such specific chemical and physical properties as are necessary for workability in the blow-lamp. This problem affects vitally a whole section of the industry—the lamp-blown scientific glassware section—for glass tubing is the raw material of this section, and the problems involved in making many precise and important instruments (*e.g.* butyrometers, clinical and other thermometers, hydrometers, etc.) are nearly all solved when the proper tubing can be accurately and consistently produced.

There are at the present time approximately four hundred firms engaged in glass and glassware manufacture in the United Kingdom, employing about 50,000 workers. It is anticipated that the research work of the association will commence in earnest at the beginning of next year. Before that date the council of the association hopes that every one of these four hundred firms will have applied for membership.

The report of the provisional committee to the general meeting on October 14 showed that a membership of 107 had already been reached; that a promise had been secured from the Committee of the Privy Council for Scientific and Industrial Research to pay to the association a total grant not exceeding 75,000*l.* within a period of five years on condition that during this period members of the association contribute an aggregate sum of not less than 5000*l.* per annum in subscriptions. The financial statement also revealed that towards this sum of 5000*l.* per annum promises from the 107 members had reached 4654*l.* 10*s.* (subscriptions from members are on a voluntary basis from 10*l.* to 1000*l.* per annum, according to ability to pay), and, in addition to this, the association had received a handsome donation of 1000*l.* from a well-known firm of glass manufacturers.

In addressing this first general meeting of the Glass Research Association, Sir Frank Heath, Secretary of the Department of Scientific and Industrial Research, who with his colleagues has rendered invaluable assistance to the promoters of the association, congratulated the members upon having brought together in this scheme of co-operative research such diverse sections of a complex industry, and also upon the particularly high financial contribution secured from the Government, due to the inclusion of unstable "key" industry sections of the glass industry, and the recognition that, in spite of the great things already accomplished in the production of these special types of glassware, an enormous amount of research and experimental work is still necessary to place these sections on a firm foundation.

Referring to various phases of the future activities of the Glass Research Association, Sir Frank Heath suggested that existing facilities such as those available at the National Physical Laboratory and the Sheffield University Department of Glass Technology should be used to the utmost, at any rate in the initial stages; that a bureau of information should be established; and that very careful efforts should be made to obtain the right director of research. The importance of his being able to win the best from his research workers by "team-work" was mentioned. In this connection the council of the association wishes it to be widely known amongst scientific workers that it is anxious to secure that the best available scientific brains and ability shall be devoted to the

problems of this industry. There can be no doubt as to the value of the opportunity offered for research, the attractiveness of the subjects for investigation, and the huge difficulties to be surmounted. The ideal director for this association is not an individual research worker whose glory is to work in splendid isolation, but is he who will bring expert knowledge of the methods of scientific research to bear upon these complex problems, who possesses such personality as to attract promising young research workers to his side, and who is also an administrator qualified to secure the carrying on of a large volume of research work along a broad front touching the various sectional interests concerned, and to co-ordinate the efforts being made through the various laboratories, institutions, and works to which specific research and experimental work will be allotted.

In an advertisement which has appeared for a director of research a lower limit to the salary has been mentioned, but it may here be stated that the council intends to pay a salary commensurate with the qualifications of the candidate selected to fill the office, and it will be very considerably higher than the figure mentioned if the council can obtain its ideal director.

There are brilliant opportunities in this field of scientific investigation for the chemist, the physicist, and the engineer. Glass engineering in particular is in its infancy in this country, and the modern problems of glass manufacture are rapidly resolving themselves into those to be solved mainly by the highly trained engineer who specialises in the study of glass-making processes.

The Glass Research Association is an earnest effort to carry out co-operative research on an extensive scale for an industry of prime national importance, and it has been launched with great promise. Everything now depends upon the support of the whole industry and upon the calibre of the scientific workers who will undertake the investigations.

It is not too much to hope that the present membership will soon be doubled, and that scientific ability and genius of the highest order will be found to energise this great undertaking and ensure its success.

EDWARD MEIGH.

THE TOBACCO BEETLE.

BULLETIN No. 737 of the United States Department of Agriculture, published last March, has for its subject "The Tobacco Beetle: An Important Pest in Tobacco Products," and on reading what its writer, Mr. G. H. Runner, has to say about the pest, one is almost tempted to believe that the "precious herbe" is fitted for nothing so much as the breeding of maggots. At any rate, Mr. Runner makes it quite clear that tobacco at every stage of its manufacture, from the dried leaf up to the finished product, is a most attractive diet for the grub or larva, and that the conditions under which the leaf is usually manufactured and stored are almost ideal for the development and reproduction of the beetle. What a pity King James did not know all this when he wrote his "Counterblaste," and was led in irony to exclaim, "O omnipotent power of tobacco!" But the tobacco beetle, *Lasioderma serricorne*, was probably altogether unknown in his days, and even now is not at all common in England. It cannot withstand exposure to extreme cold for any great length of time, and thrives best, sometimes reproducing at the unusual rate of three or more generations each year, where a warm, equable temperature, a moist atmosphere, and suitable food for the grub occur together. That is why it is so much better known in America, especially in the States bordering on the Gulf of Mexico, than it is in this country. It is well known also in India and the islands of the Far East.

Here in England the tobacco beetle is an imported species, only occasionally met with, though sometimes in very large numbers, as was the case not many years ago when it swarmed in the warehouses around one of the London docks, whither it had come in a cargo of turmeric from India. Its larvæ feed, like those of the common "biscuit weevil" or "drug-store beetle," *Sitodrepa panicea*, which belongs to the same family, on almost every kind of dried product of vegetable origin. Hence the beetle is almost as much at home with the druggist and the grocer as it is with the tobacconist. Tobacco, however, except in the green or growing state, which it does not touch, appears to be its principal food, and, according to Mr. Runner, it selects the higher grades of leaf, cigar, and cigarette in preference to those of inferior quality.

Methods to be taken for the destruction or control of the little pest, and various experiments and trials made with that object in view, are described at some length in the bulletin, which contains as well a full account of the whole life-history of the insect illustrated by figures, some of which are particularly well done, and there is also a list of special memoirs and other papers relating to the subject. The bulletin, therefore, although apparently prepared more especially for the benefit of the tobacco manufacturer and dealer, will be of considerable value to the practical entomologist, and ought, indeed, to have some interest also for every true lover of the weed.

THE BRITISH ASSOCIATION AT BOURNEMOUTH.

SECTION H.

ANTHROPOLOGY.

OPENING ADDRESS BY PROF. ARTHUR KEITH, M.D., LL.D., F.R.S., PRESIDENT OF THE SECTION.

The Differentiation of Mankind into Racial Types.

FOR a brief half-hour I am to try to engage your attention on a matter which has excited the interest of thoughtful minds from ancient times—the problem of how mankind has been demarcated into types so diverse as the Negro, the Mongol, and the Caucasian or European. For many a day the Mosaic explanation—the tower of Babel theory—was regarded as a sufficient solution of this difficult problem. In these times most of us have adopted an explanation which differs in many respects from that put forward in the book of Genesis; Noah disappears from our theory and is replaced in the dim distance of time by a "common ancestral stock." Our story now commences, not at the close of an historical flood, but at the end of a geological epoch so distant from us that we cannot compute its date with any degree of accuracy. Shem, Ham, and Japheth, the reputed ancestors of the three great racial stocks of modern times—the white, black, and yellow distinctive types of mankind—have also disappeared from our speculations; we no longer look out on the world and believe that the patterns which stud the variegated carpet of humanity were all woven at the same time; some of the patterns, we believe, are of ancient date and have retained many of the features which marked the "common ancestral" design; others are of more recent date, having the ancient pattern altered in many of its details. We have called in, as Darwin has taught us, the whole machinery of evolution—struggle for existence, survival of the fittest, spontaneous origin of structural variations, the inheritance of such variations—as the loom by which Nature

fashions her biological patterns. We have replaced the creative finger by the evolutionary machine, but no one is more conscious of the limitations of that machine than the student of human races. We are all familiar with the features of that racial human type which clusters round the heart of Africa; we recognise the Negro at a glance by his black, shining, hairless skin, his crisp hair, his flattened nose, his widely opened dark eyes, his heavily moulded lips, his gleaming teeth and strong jaws. He has a carriage and proportion of body of his own; he has his peculiar quality of voice and action of brain. He is, even to the unpractised eye, clearly different from the Mongolian native of North-Eastern Asia; the skin, the hair, the eyes, the quality of brain and voice, the carriage of body and proportion of limb to body pick out the Mongol as a sharply differentiated human type. Different from either of these is the native of Central Europe—the Aryan or Caucasian type of man; we know him by the paleness of his skin and by his facial features—particularly his narrow, prominent nose and thin lips. We are so accustomed to the prominence of the Caucasian nose that only a Mongol or Negro can appreciate its singularity in our Aryanised world. When we ask how these three types—the European, Chinaman, and Negro—came by their distinctive features, we find that our evolutionary machine is defective; the processes of natural and of sexual selection will preserve and exaggerate traits of body and of mind, but they cannot produce that complex of features which marks off one racial type from another. Nature has at her command some secret mechanism by which she works out her new patterns in the bodies of man and beast—a mechanism of which we were almost ignorant in Darwin's day, but which we are now beginning to perceive and dimly understand. It is the bearing of this creative or morphogenetic mechanism on the evolution of the modern races of mankind which I propose to make the subject of my address.

Hid away in various parts of the human frame is a series of more or less obscure bodies or glands, five in number, which, in recent times, we have come to recognise as parts of the machinery which regulate the growth of the body. They form merely a fraction of the body—not more than 1/180th part of it: a man might pack the entire series in his watch-pocket. The modern medical student is familiar with each one of them—the pituitary body, about the size of a ripe cherry, attached to the base of the brain and cradled in the floor of the skull; the pineal gland, also situated in the brain, and in point of size but little larger than a wheat-grain; the thyroid in the neck, set astride the windpipe, forms a more bulky mass; the two suprarenal bodies situated in the belly, capping the kidneys, and the interstitial glands embedded within the substance of the testicle and ovary, complete the list. The modern physician is also familiar with the fact that the growth of the body may be retarded, accelerated, or completely altered if one or more of these glands become the seat of injury or of a functional disorder. It is thirty-three years now since first one woman and then another came to Dr. Pierre Marie in Paris seeking relief from a persistent headache, and mentioning incidentally that their faces, bodies, hands, and feet had altered so much in recent years that their best-known friends failed to recognise them. That incident marked the commencement of our knowledge of the pituitary gland as an intrinsic part of the machinery which regulates the shaping of our bodies and features. Dr. Marie named the condition acromegaly. Since then hundreds of men and women showing symptoms similar to those of Dr. Marie's patients have been seen and diagnosed, and in every instance where the acromegalic changes were typical and marked there has been found a definite enlargement or tumour of the pituitary body. The practised eye recognises the full-blown condition of acromegaly at a glance, so characteristic are the features of the sufferers. Nay, as we walk along the streets we can note slight degrees of it—degrees which fall far short of the borderline of disease; we note that it may give characteristic traits to a whole family—a family marked by what may be named an acromegalic taint. The pituitary gland is also concerned in another disturbance of growth—giantism. In every case where a young lad has shot up, during his late "teens," into a lanky man of seven feet or more—has become a giant—it has been found that his pituitary gland was the site of a disordered enlargement. The pituitary is part of the mechanism which regulates our stature, and stature is a racial characteristic. The giant is usually acromegalic as well as tall, but the two conditions need not be combined; a young lad may undergo the bodily changes which characterise acromegaly and yet not become abnormally tall, or he may become—although this is rarely the case—a giant in stature and yet may not assume acromegalic features. There is a third condition of disordered growth in which the pituitary is concerned—one in which the length of the limbs is disproportionately increased—in which the sexual system and all the secondary sexual characters of body and mind either fail to develop or disappear—where fat tends to be deposited on the body, particularly over the buttocks and thighs—where, in brief, a eunuchoid condition of body develops. In all these three conditions we seem to be dealing with a disordered and exaggerated action of the pituitary gland; there must be conditions of an opposite kind where the functions of the pituitary are disordered and reduced. A number of cases of dwarfism have been recorded where boys or girls retained their boyhood or girlhood throughout life, apparently because their pituitary gland had been invaded and partly destroyed by tumours. We shall see that dwarfism may result also from a failure of the thyroid gland. On the evidence at our disposal, evidence which is being rapidly augmented, we are justified in regarding the pituitary gland as one of the principal pinions in the machinery which regulates the growth of the human body and is directly concerned in determining stature, cast of features, texture of skin, and character of hair—all of them marks of race. When we compare the three chief racial types of humanity—the Negro, the Mongol, and the Caucasian or European—we can recognise in the last-named a greater predominance of the pituitary than in the other two. The sharp and pronounced nasalisation of the face, the tendency to strong eyebrow ridges, the prominent chin, the tendency to bulk of body and height of stature in the majority of Europeans, is best explained, so far as the present state of our knowledge goes, in terms of pituitary function.

There is no question that our interest in the mechanism of growth has been quickened in recent years by observations and discoveries made by physicians on men and women who suffered from pituitary disorders, but that a small part of the body could influence and regulate the growth and characterisation of the whole was known in ancient times. For many centuries it has been common knowledge that the removal of the genital glands alters the external form and internal nature of man and beast. The sooner the operation is performed after birth, the more certain are its effects. Were a naturalist from a unisexual world to visit this earth of ours it would be difficult to convince him that a

brother and a sister were of the same species, or that the wrinkled, sallow-visaged eunuch with his beardless face, his long, tapering limbs, his hesitating carriage, his carping outlook, and corpulent body was brother to the thick-set, robust, pugilistic man with the bearded face. The discovery that the testicle and ovary contain, scattered throughout their substance, a small glandular element which has nothing to do with their main function—the production of genital cells—was made seventy years ago, but the evidence which leads us to believe that this scattered element—the interstitial gland—is directly concerned in the mechanism of growth is of quite recent date. All those changes which we may observe in the girl or boy at puberty—the phase of growth which brings into full prominence their racial characteristics—depend on the action of the interstitial glands. If they are removed or remain in abeyance the maturation of the body is both prolonged and altered. In seeking for the mechanism which shapes mankind into races we must take the interstitial gland into our reckoning. I am of opinion that the sexual differentiation—the robust manifestations of the male characters—is more emphatic in the Caucasian than in either the Mongol or Negro racial types. In both Mongol and Negro, in their most representative form, we find a beardless face and almost hairless body, and in certain Negro types, especially in Nilotic tribes, with their long, stork-like legs, we seem to have a manifestation of abeyance in the action of the interstitial glands. At the close of sexual life we often see the features of a woman assume a coarser and more masculine appearance.

Associated with the interstitial glands, at least in point of development, are the suprarenal bodies or glands. Our knowledge that these two comparatively small structures, no larger than the segments into which a moderately sized orange can be separated, are connected with pigmentation of the skin dates back to 1894, when Dr. Thomas Addison, a physician to Guy's Hospital London, observed that gradual destruction of these bodies by disease led to a darkening or pigmentation of the patient's skin, besides giving rise to other more severe changes and symptoms. Now it is 150 years since John Hunter came to the conclusion, on the evidence then at his disposal, that the original colour of man's skin was black, and all the knowledge that we have gathered since his time supports the inference he drew. From the fact that pigment begins to collect in and thus darken the skin when the suprarenal bodies become the seat of a destructive disease we infer that they have to do with the clearing away of pigment, and that we Europeans owe the fairness of our skins to some particular virtue resident in the suprarenal bodies. That their function is complex and multiple the researches of Sir E. A. Sharpey Schafer, of T. R. Elliott, and of W. B. Cannon have made very evident. Fifteen years ago Bulloch and Sequeira established the fact that when a suprarenal body becomes the site of a peculiar form of malignant overgrowth in childhood, the body of the boy or girl undergoes certain extraordinary growth changes. The sexual organs become rapidly mature, and through the framework of childhood burst all the features of sexual maturity—the full chest, muscularity of limbs, bass voice, bearded face, and hairy body—a miniature Hercules—a miracle of transformation in body and brain. Corresponding changes occur in young girls—almost infants in years—with a tendency to assume features which characterise the male. Prof. Glynn (*Quart. Journ. of Med.*, vol. v., p. 157, 1912) has recently collected such cases and systematised our knowledge of these strange derangements of growth. There can be no doubt that the suprarenal bodies constitute an important part of the mechanism which regulates the development and growth of the human body and helps in determining the racial characters of mankind. We know that certain races come more quickly to sexual maturity than others, and that races vary in development of hair and of pigment, and it is therefore reasonable to expect a satisfactory explanation of these characters when we have come by a more complete knowledge of the suprarenal mechanism.

During the last few years the totally unexpected discovery has been sprung upon us that disease of the minute pineal gland of the brain may give rise to a train of symptoms very similar to those which follow tumour formation of the cortex of the suprarenal bodies. In some instances the sudden sexual prematurity which occurs in childhood is apparently the immediate result of a tumour-like affection of the pineal gland. We have hitherto regarded the pineal gland, little bigger than a wheat-grain and buried deeply in the brain, as a mere useless vestige of a median or parietal eye, derived from some distant human ancestor in whom that eye was functional, but on the clinical and experimental evidence now rapidly accumulating we must assign to it a place in the machinery which controls the growth of the body.

We come now to deal with the thyroid gland, which, from an anthropological point of view, must be regarded as the most important of all the organs or glands of internal secretion. Here, too, in connection with the thyroid gland, which is situated in the front of the neck, where it is so apt to become enlarged and prominent in women, I must direct attention to a generalisation which I slurred over when speaking of the pituitary and suprarenal glands. Each of these glands throws into the circulating blood two sets of substances—one set to act immediately in tuning the parts of the body which are not under the influence of the will to the work they have to do when the body is at rest and when it is making an effort; another set of substances—which Prof. Gley has named morphogenetic—has not an immediate but a remote effect; they regulate the development and co-ordinate the growth of the various parts of the body. Now, so far as the immediate function of the thyroid is concerned, our present knowledge points to the gland as the manufactory of a substance which, when circulating in the body, regulates the rate of combustion of the tissues; when we make a muscular effort, or when our bodies are exposed to cold, or when we become the subjects of infection, the thyroid is called upon to assist in mobilising all available tissue-fuel. If we consider only its immediate function it is clear that the thyroid is connected with the selection and survival of human races. When, however, we consider its remote or morphogenetic effects on growth, its importance as a factor in shaping the characteristics of human races becomes even more evident. In districts where the thyroid is liable to that form of disease known as goitre it has been known for many a year that children who were affected became cretins—dwarf idiots with a very characteristic appearance of face and body.[1] Disease of the thyroid stunts and alters the growth of the body so that the subjects of this disorder might well be classed as a separate species of humanity. If the thyroid becomes diseased and defective after growth of the body is completed, then certain changes, first observed by Sir William Gull in 1873, are set up and give rise to the disordered state of the body known as myxœdema. "In this state," says Sir Malcolm

[1] The story of the discovery of the action of the thyroid gland is told by Prof. G. M. Murray, *Brit. Med. Journ.*, ii., p. 163, 1913.

Morris (*Brit. Med. Journ.*, i., p. 1038, 1913), "the skin is cold, dry, and rough, seldom or never perspires, and may take on a *yellowish* tint; there is a bright red flush in the malar region. The skin as a whole looks transparent; the hair of the scalp becomes scanty; the pubic and axillary hair, with the eyelashes and eyebrows, often falls out; in many cases the teeth are brittle and carious. All these appearances disappear under the administration of thyroid extract." We have here conclusive evidence that the thyroid acts directly on the skin and hair, just the structures we employ in the classification of human races. The influence of the thyroid on the development of the other systems of the body, particularly on the growth of the skull and skeleton, is equally profound. This is particularly the case as regards the base of the skull and the nose. The arrest of growth falls mainly on the basal part of the skull, with the result that the root of the nose appears to be flattened and drawn backwards between the eyes, the upper forehead appears projecting or bulging, the face appears flattened, and the bony scaffolding of the nose, particularly when compared with the prominence of the jaws, is greatly reduced. Now these facial features which I have enumerated give the Mongolian face its characteristic aspect, and, to a lesser degree, they are also to be traced in the features of the Negro. Indeed, in one aberrant branch of the Negro race—the Bushman of South Africa—the thyroid facies is even more emphatically brought out than in the most typical Mongol. You will observe that, in my opinion, the thyroid—or a reduction or alteration in the activity of the thyroid—has been a factor in determining some of the racial characteristics of the Mongol and the Negro races. I know of a telling piece of evidence which supports this thesis. Some years ago there died in the East End of London a Chinese giant—the subject, we must suppose, of an excessive action of the pituitary gland—the gland which I regard as playing a predominant part in shaping the face and bodily form of the European. The skeleton of this giant was prepared and placed in the Museum of the London Hospital Medical College by Col. T. H. Openshaw, and anyone inspecting that skeleton can see that, although certain Chinese features are still recognisable, the nasal region and the supra-orbital ridges of the face have assumed the more prominent European type.

There are two peculiar and very definite forms of dwarfism with which most people are familiar, both of which must be regarded as due to a defect in the growth-regulating mechanism of the thyroid. Now, one of these forms of dwarfism is known to medical men as achondroplasia, because the growth of cartilage is particularly affected, but in familiar language we may speak of the sufferers from this disorder of growth as being of the "bulldog breed" or of the "dachshund breed." In the dachshund the limbs are greatly shortened and gnarled, but the nose or snout suffers no reduction, while in the bulldog the nose and nasal part of the face are greatly reduced and withdrawn, showing an exaggerated degree of Mongolism. Among achondroplastic human dwarfs both breeds occur, but the "bulldog" form is much more common than the "dachshund" type. The shortening of limbs with retraction of the nasal region of the face—pug-face or prosopia we may call the condition—has a very direct interest for anthropologists, seeing that short limbs and a long trunk are well-recognised racial characteristics of the Mongol. In the second kind of dwarfism, which we have reason to regard as due to a functional defect of the thyroid, the Mongolian traits are so apparent that the sufferers from this disorder are known to medical men as "Mongolian idiots"—for not only is their growth stunted, but their brains also act in a peculiar and aberrant manner. Dr. Langdon Down, who gave the subjects of this peculiar disorder the name "Mongolian idiots" fifty-five years ago, knew nothing of the modern doctrine of internal secretions, but that doctrine has been applied in recent years by Dr. F. G. Crookshank ("The Universal Medical Record," vol. iii., p. 12, 1913) to explain the features and condition of Mongoloid imbecile children. Some years ago (*Journ. of Anat. and Physiol.*, 1913) I brought forward evidence to show that we could best explain the various forms of anthropoid apes by applying the modern doctrine of a growth-controlling glandular mechanism. In the gorilla we see the effects of a predominance of the pituitary elements; in the orang, of the thyroid. The late Prof. Klaatsch tried to account for the superficial resemblances between the Malay and the orang by postulating a genetic relationship between them; for a similar reason he derived the Negro type from a gorilline ancestry. Occasionally we see a man or woman of supposedly pure European ancestry displaying definite Mongoloid traits in their features. We have been in the habit of accounting for such manifestations by the theory, at one time very popular, that a Mongoloid race had at one time spread over Europe, and that Mongoloid traits were atavistic recurrences. An examination of the human remains of ancient Europe yields no evidence in support of a Turanian or Mongol invasion of Europe.

All these manifestations to which I have been directing your attention—the sporadic manifestation of Mongoloid characters in diseased children and in healthy adult Europeans, the generic characters which separate one kind of ape from another, the bodily and mental features which mark the various races of mankind—are best explained by the theory I am supporting, namely, that the conformation of man and ape and of every vertebrate animal is determined by a common growth-controlling mechanism which is resident in a system of small but complex glandular organs. We must now look somewhat more closely into the manner in which this growth-regulating mechanism actually works. That we can do best by taking a glimpse of a research carried out by Bayliss and Starling in the opening years of the present century. They were seeking to explain why it was that the pancreas poured out its digestive juice as soon as the contents of the stomach commenced to pass into the first part of the duodenum. It was then known that if acid was applied to the lining epithelial membrane of the duodenum, the pancreas commenced to work; it was known also that the message which set the pancreas into operation was not conveyed from the duodenum to the pancreas by nerves, for when they were cut the mechanism was still effective. Bayliss and Starling solved the puzzle by making an emulsion from the acid-soaked lining epithelium of the duodenum and injecting the extract of that emulsion into the circulating blood. The result was that the pancreas was immediately thrown into activity. The particular substance which was thus set circulating in the blood and acted on the pancreas, and on the pancreas alone, and thus served as a messenger or hormone, they named secretin. They not only cleared up the mechanism of pancreatic secretion, but at the same time made a discovery of much greater importance. They had discovered a new method whereby one part of the human body could communicate with and control another. Up to that time we had been like an outlandish visitor to a strange city, who believed that the visible telegraph or telephone wires were the only means of com-

munication between its inhabitants. We believed that it was only by nerve-fibres that intercommunication was established in the animal body. Bayliss and Starling showed that there was a postal system. Missives posted in the general circulation were duly delivered at their destinations. The manner in which they reached the right address is of particular importance for us; we must suppose that the missive or hormone circulating in the blood and the recipient for which they are intended have a special attraction or affinity for each other—one due to their physical constitution—and hence they, and only they, come together as the blood circulates round the body. Secretin is a hormone which effects its errand rapidly and immediately, whereas the growth or morphogenetic hormones, thrown into the circulation by the pituitary, pineal, thyroid, suprarenal, and genital glands, act slowly and remotely. But both are alike in this: the result depends not only on the nature of the hormone or missive, but also on the state of the local recipient. The local recipient may be specially greedy, as it were, and seize more than a fair share of the manna in circulation, or it may have "sticky fingers" and seize what is not really intended for local consumption. We can see that local growth—the development of a particular trait or feature—is dependent not only on the hormones supplied to that part, but also on the condition of the receptive mechanism of the part. Hence we can understand a local derangement of growth—an acromegaly or giantism confined to a finger or to the eyebrow ridges, to the nose, to one side of the face, and such local manifestations are not uncommon. It is by a variation in the sensitiveness of the local recipient that we have an explanation of the endless variety to be found in the relative development of racial and individual features.

Some ten years after Starling had formulated the theory of hormones, Prof. W. B. Cannon, of Harvard University, piercing together the results of researches by Dr. T. R. Elliott and by himself on the action of the suprarenal glands, brought to light a very wonderful hormone mechanism—one which helps us in interpreting the action of growth-regulating hormones. When we are about to make a severe bodily effort it is necessary to flood our muscles with blood, so that they may have at their disposal the materials necessary for work—oxygen and blood-sugar, the fuel of muscular engines. At the beginning of a muscular effort the suprarenal glands are set going by messages passing to them from the central nervous system; they throw a hormone—adrenalin—into the circulating blood, which has a double effect; adrenalin acts on the flood-gates of the circulation, so that the major supply of blood passes to the muscles. At the same time it so acts on the liver that the blood circulating through that great organ becomes laden with blood-sugar. We here obtain a glimpse of the neat and effective manner in which hormones are utilised in the economy of the living body. From that glimpse we seem to obtain a clue to that remarkable disorder of growth in the human body known as acromegaly. It is a pathological manifestation of an adaptational mechanism with which we are all familiar. Nothing is better known to us than that our bodies respond to the burden they are made to bear. Our muscles increase in size and strength the more we use them; increase in the size of our muscles would be useless unless our bones also were strengthened to a corresponding degree. A greater blood supply is required to feed them, and hence the power of the heart has to be augmented; more oxygen is needed for their consumption, and hence the lung capacity has to be increased; more fuel is required—hence the whole digestive and assimilative systems have to undergo a hypertrophy, including the apparatus of mastication. Such a power of co-ordinated response on the part of all the organs of the body to meet the needs of athletic training presupposes a co-ordinating mechanism. We have always regarded such a power of response as an inherent property of the living body, but in the light of our growing knowledge it is clear that we are here dealing with an hormonic mechanism, one in which the pituitary gland is primarily concerned. When we study the structural changes which take place in the first phase of acromegaly (see Keith, *Lancet*, ii., p. 993, 1911; i., p. 305, 1913), we find that not only are the bones enlarged and overgrown in a peculiar way, but also the muscles, the heart, the lungs, the organs of digestion, particularly the jaws; hence the marked changes in the face, for the form of the face is determined by the development of the upper and lower jaws. The rational interpretation of acromegaly is that it is a pathological disorder of the mechanism of adaptational response; in the healthy body the pituitary is throwing into the circulation just a sufficiency of a growth-regulating substance to sensitise muscles, bones, and other structures to give a normal response to the burden thrown on the body. But in acromegaly the body is so flooded with this substance that its tissues become hypersensitive and respond by overgrowth to efforts and movements of the slightest degree. It is not too much to expect, when we see how the body and features become transformed at the onset of acromegaly, that a fuller knowledge of these growth-mechanisms will give us a clue to the principles of race differentiation.

There must be many other mechanisms regulated by hormones with which we are as yet totally unacquainted. I will cite only one instance—that concerned in regulating the temperature of the body. We know that the thyroid and also the suprarenal glands are concerned in this mechanism; they have also to do with the deposition and absorption of pigment in the skin, which must be part of the heat-regulating mechanism. It is along such a path of inquiry that we expect to discover a clue to the question of race colour.

This is not the first occasion on which the doctrine of hormones has been applied to biological problems at the British Association. In his presidential address to the Zoological Section at Sheffield in 1910 Prof. G. C. Bourne applied the theory to the problems of evolution; its bearing was examined in more detail in an address to the same section by Prof. Arthur Dendy during the meeting at Portsmouth in 1911. At the meeting of the association at Newcastle in 1916 Prof. MacBride devoted part of his address to the morphogenetic bearings of hormones. Very soon after Starling formulated the hormone theory, Dr. J. T. Cunningham applied it to explain the phenomena of heredity (Proc. Zool. Soc. London, p. 434, 1908). Nay, rightly conceived, Darwin's theory of pan-genesis is very much of the same character as the modern theory of hormones.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Prof. G. H. F. Nuttall, Quick professor of biology, has received from Mr. P. A. Molteno, of Trinity College, a letter dated October 23 desiring to present to the University a sum of 20,000*l.* to provide suitable buildings and fittings for an institute for research in parasitology, and a further sum of 10,000*l.* to provide an income for the upkeep and maintenance of the institute. Plans have been drawn

up by Mr. Harry Redfern for the erection of this institute on the Downing site.

The special lectures by Sir J. J. Thomson on positive rays, and by Prof. Eddington on the theory of relativity and gravitation, have been postponed until the Lent term.

The recommendations of the General Board of Studies on (*a*) a proposed readership in geography, (*b*) a proposed readership in agricultural physiology, and (*c*) a proposed readership in estate management have been passed by the Senate.

The University is full to overflowing, and the difficulty of obtaining accommodation has been met only partially by extending the limits to a 2½-mile radius from Great St. Mary's Church. Practically all the colleges are strictly limiting their numbers. One of the most striking characteristics of the post-war population is the enormous increase in the numbers of men pursuing the study of natural, economic, and mechanical sciences. For example, the engineering school has now between 600 and 700 students; in the chemistry school between 1100 and 1200 names have been entered for lectures and nearly 1000 for practical work; while, instead of the 100 expected, some 240 students attended the elementary class in physiology. The difficulties of accommodation are severe now, but next year and the year after, when these students have passed the elementary stage and require more elaborate equipment and teaching, the situation will be almost impossible unless steps are taken to increase the laboratory accommodation and teaching resources. The difficulty in doing so is partly that of building—though, fortunately, the building strike has just been settled—and partly that of providing the funds required for construction, equipment, and *personnel*. Some help in this direction may be expected from the State, but the State will not be able to replace the private benefactor in assisting the University in its present exceptional opportunity of promoting the teaching of and research in science.

OXFORD.—The question of admitting women to matriculation and degrees has entered upon a new phase. It had been intended to seek Parliamentary sanction for the framing by the University of provisions for the removal of the academic disabilities of women. It now appears that, by the unsolicited action of the House of Commons itself, the way will be opened for the admission of women to matriculation and degrees without any special appeal to Parliament for the purpose. Legislation with this object will probably be undertaken in the near future.

Col. Thomas E. Lawrence, a leading authority on the topography, ethnology, and languages of Arabia and Mesopotamia, distinguished also for his political and military services in the late Arabian anti-Turkish campaign, has been elected to a research fellowship at All Souls College.

In Congregation on November 11, the statute making Greek optional in Responsions, which was thrown out by Convocation in June last, was re-introduced with a fresh preamble, under which it will be possible for amendments to be moved limiting the exemption from compulsory Greek to candidates for honours in science or mathematics, and to candidates for a pass degree. The preamble, after speeches by Mr. Barker, of New College, and Prof. Gilbert Murray, passed without a division.

DR. J. H. GRINDLEY, of Cork, has been appointed principal of the Dudley Technical College.

DR. ALEX HILL is resigning the principalship of University College, Southampton, in order to devote his full activities to the Universities Bureau, of which he is secretary.

MISS M. E. LAING has been appointed research assistant in physical chemistry in connection with the Leverhulme chair of physical chemistry at the University of Bristol.

A READER in estate management is shortly to be appointed by the General Board of Studies of the University of Cambridge at an annual stipend of 500*l*. Applications for the post must be sent to the Vice-Chancellor on or before November 30.

APPLICATIONS are invited by the Senate of the University of London for the Keddey Fletcher-Warr studentships for the promotion of post-graduate research. The studentships are open to men and women, tenable for three years, and of the annual value of not less than 200*l*. Applications must be received by the Academic Registrar of the University of London, South Kensington, S.W.7, not later than December 31 next.

A SERIES of free public lectures has been arranged for delivery in the botanical lecture-room of the University of Glasgow during the winter session, 1919–20, at 8.30 p.m., on the second Monday of each month from November to March inclusive. The list of lectures, including that by Prof. C. H. Desch, on November 10, on "The Growth of Crystals," is as follows:—On December 8, "Scotland and France," Prof. R. S. Rait; on January 12, "The Language of the Poilus"; on February 9, "The Beginnings of Geography," Prof. J. W. Gregory; and on March 8, "Finance and Reconstruction," Prof. W. R. Scott.

PROF. JOHN COX will resume on Monday next, at 6.30 p.m., the course of lectures on modern scientific discoveries and their practical application to life and industry at Gresham College, Basinghall Street, E.C.2, by a lecture on "Oerstedt and the Telegraph." These lectures are given mainly with the view of enforcing the need that applied science is necessary, not only for the commercial prosperity of any modern community, but also for its very existence. Other lectures in the course deal with long-distance telephony, the motor and dynamo, the nature of light, streamlines and aeroplanes, sound-ranging, directional wireless, listening under water, radio-activity, etc.

THE annual general meeting of the Science Masters' Association will be held at the London Day Training College, Southampton Row, W.C.1, on Tuesday and Wednesday, January 6 and 7, 1920, under the presidency of Mr. W. W. Vaughan, master of Wellington College. Among the subjects to be discussed are:—The Teaching of Organic Chemistry; Biology in the School Science Syllabus; Laboratory Management—(*a*) Training of Assistants and (*b*) Cost of Apparatus; Science Teaching in the Early Stages—(*a*) Science in the Preparatory School and in Common Entrance and Entrance Scholarship Examinations for Public Schools, and (*b*) Teaching Junior Forms; and The Divorce of Laboratory and Class-room Courses.

A CONFERENCE of representative men and women which met at the Bedford College for Women (University of London) on November 5 unanimously decided on carrying out an extension which will involve an appeal to the public for funds. In order to organise the appeal, an executive committee has been appointed, of which Col. Sir Hildred Carlile, Bart., M.P., is chairman and Viscountess Elveden hon. treasurer. The college, built to accommodate 400 students, now has 550. The proportion of science students has greatly increased, and is now one-third of the total number. In the chemistry department the students number 130, and the working places are only forty-six. In the matter of residence the same difficulties occur; despite the addition of three new

hostels, there remains this term a long waiting list of students wishing to come into residence. It is hoped that the appeal will enable the college to make provision for the increased demands made upon it by the attention now given to higher education for women.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, October 21.—Prof. E. W. MacBride, vice-president, in the chair.—E. G. **Boulenger**: Report on the research experiments on methods of rat destruction carried out at the society's gardens.—Dr. A. Smith **Woodward**: The zoological position and affinities of Tarsius.

PARIS.

Academy of Sciences, October 13.—M. Léon Guignard in the chair.—C. **Moureu** and C. **Dufraisse**: The stabilisation of acrolein. The methods of spontaneous alteration of acrolein. The spontaneous transformation into disacryl, the soluble resin, appears to be a modification undergone by pure acrolein. Acrolein purified with the greatest care always underwent this spontaneous condensation on standing. The speed of transformation can be modified by light, high temperature, and the presence of impurities.—R. **Bourgeois**: A collection of paintings of clouds.—M. **Leblanc**: Very rapid rotations.—P. **Boutroux**: A family of multiform functions, integrals of a differential equation of the first order.—J. **Andrade**: The weighing of a friction during the relative sliding of two solids in contact.—E. **Belot**: The movement of translation of a gaseous vortex ring in a resisting medium.—H. **Vanderlinden**. The ephemeris of the Borrelly comet, 1919c.—G. **Sagnac**: The absolute mechanics of waves and the Newtonian relativity of energy.—Q. **Majorana**: Gravitation.—G. **Claude**: The industrial employment of extremely high pressures. In compressing gases to pressures of 1000 atmospheres, no difficulties may be expected to arise in the pumps of the compressors or in the receivers, which can easily be made of sufficient strength to give security. The real difficulty will arise in the connections, which must be absolutely tight if serious losses are to be avoided. The author has constructed apparatus which, after charging with gas compressed to 1000 atmospheres and immersing in water, allowed no bubbles of gas to escape.—A. **Bolland**: Microchemical reactions of thiosulphuric acid.—V. **Cremieu** and A. **Lepape**: The separation by solidification of pure carbon dioxide from a gaseous mixture. Starting with a mixture containing 95 per cent. of carbon dioxide, cooling to −80° C., and compressing slightly, the solid carbon dioxide precipitated is chemically pure.—J. **Guyot** and L. J. **Simon**: The action of concentrated sulphuric acid on methyl alcohol.—J. **Révil** and P. **Combaz**: The age and the conditions of formation of the lignites of Voglans in the Chambéry region. A discussion and criticism of the views recently put forward by M. Corroix.—J. **Barthoux**: Succession of old eruptive rocks in the Arabian Desert.—J. **Pellegrin**: New contribution to the ichthyological fauna of Lake Tchad.—F. **Ladreyt**: The complex symbiotic cell.—J. **Amar**: Respiration in confined air.—F. **Bordas**: The preparation and conservation of sera and vaccines by drying in an absolute vacuum. The vaccines are dried in a high vacuum and the water-vapour evolved is removed by freezing. After drying, the tube is sealed and the vaccine thus removed from the action of both water and oxygen. The activity of such preparations can be preserved for several years.

October 20.—M. Léon Guignard in the chair.—M. **Henneguy**: An account of the work of the late Gustav Retzius.—G. **Bigourdan**: A project of uranographic classification, completing other classifications in present use.—A. **Blondel**: The characteristics of oscillation of lamps with three electrodes, utilised as generators of sustained oscillations.—M. **de Chardonnet**: Remark on a communication of Gen. Bourgeois. The use of autochrome plates instead of hand-paintings for clouds is suggested as being more practical. As regards the question of the stability of the images, some coloured photographs of the sky taken ten years ago, now presented to the Academy, are still in a good state of preservation.—M. **Petrovitch**: Definite integrals, of which the decimal part is expressed with the aid of prime numbers.—G. **Kolossoff**: The movement of a solid in an indefinite liquid.—A. **Foch**: The resonance of water-mains provided with an air-chamber.—A. **Bichet**: A system of aiming at objects in the air. Suggestions for a new means of mounting telescopes, searchlights, and guns for improving the aim at moving objects in the air.—G. **Chavanne**, L. P. **Clerc**, and L. J. **Simon**: Analyses of German aviation petrols. The results given were obtained by a combination of careful fractional distillation with the measurement of the critical solution temperature of the fractions in aniline, details of which have been given in earlier communications. Twenty specimens were examined, the composition of which averaged 10 per cent. aromatic hydrocarbons, 40 per cent. saturated cyclic hydrocarbons, and 50 per cent. paraffins. The deviations of the separate specimens from the average were very small.—P. **Robin**: The peroxide of benzaldoxime. A study of the decomposition by prolonged boiling in benzene solution, and of the prolonged oxidation with iodine and sodium carbonate.—J. **Barthoux**: Cretacean volcanic rocks of Egypt and Sinai.—G. B. M. **Flamand**: The discovery of a lens of coal at Port-Gueydon. Two analyses are given, together with reasons for supposing that this deposit really belongs to the Coal Measures.—M. **Bezagu**: Variations of the respiration of leaf-cells with age.—A. **Sartory**: A new fungus of the genus Scopulariopsis isolated from a case of onychomycosis.

BOOKS RECEIVED.

The Philosophy of Conflict, and Other Essays in War-time. By H. Ellis. Second series. Pp. 299. (London: Constable and Co., Ltd.) 6*s*. 6*d*. net.

Organic Chemistry for Students of Medicine. By Prof. J. Walker. Second edition. Pp. xi+332. (London: Gurney and Jackson.) 10*s*. 6*d*. net.

Essays in Common Sense Philosophy. By C. E. M. Joad. Pp. 252. (London: The Swarthmore Press, Ltd.) 8*s*. 6*d*. net.

The Struggle in the Air, 1914–1918. By Major C. C. Turner. Pp. viii+288. (London: E. Arnold.) 15*s*. net.

Iron Bacteria. By Dr. D. Ellis. Pp. xix+179+v plates. (London: Methuen and Co., Ltd.) 10*s*. 6*d*. net.

The Venereal Problem. By E. T. Burke. Pp. 208. (London: H. Kimpton.) 7*s*. 6*d*. net.

Some Wonders of Matter. By the Right Rev. J. E. Mercer. Pp. 195. (London: S.P.C.K.) 5*s*. net.

Joseph Dalton Hooker. By Prof. F. O. Bower. Pp. 62. (London: S.P.C.K.) 2*s*. net.

Herschel. By the Rev. H. Macpherson. Pp. 78. (London: S.P.C.K.) 2*s*. net.

The Profession of Chemistry. By R. B. Pilcher. Pp. xiv+199. (London: Constable and Co., Ltd.) 6*s*. 6*d*. net.

Cambridge University Calendar for the Year 1919–1920. Pp. xxvi+1125. (Cambridge: At the University Press.) 15s. net.

Notes on Magnetism: For the Use of Students of Electrical Engineering. By C. G. Lamb. Pp. viii+94. (Cambridge: At the University Press.) 5s. net.

A Text-book of Quantitative Chemical Analysis. By Dr. A. C. Cumming and Dr. S. A. Kay. Third edition. Pp. xv+416. (London: Gurney and Jackson.) 12s. 6d. net.

Just Look! or, How the Children Studied Nature. By L. B. Thompson. Pp. viii+204+58 plates. (London: Gay and Hancock, Ltd.) 5s. net.

DIARY OF SOCIETIES.

THURSDAY, NOVEMBER 13.

ROYAL SOCIETY, at 4.30.—Lt.-Col. R. McCarrison: The Genesis of Œdema in Beriberi.—W. Robinson: The Micro-copical Features of Mechanical Strains in Timber and the Bearing of these on the Structure of the Cell-wall in Plants.—W. B. Bottomley: The Effect of Nitrogen-fixing Organisms and Nucleic Acid Derivatives on Plant Growth.—Agnes Arber: The Vegetative Morphology of *Pistia* and the Lemnaceæ.—W. J. Young, A. Breinl, J. J. Harris, and W. A. Osborne: Effects of Exercise and Humid Heat upon Pulse Rate, Blood Pressure, Body Temperature, and Blood Concentration.

ROYAL COLLEGE OF PHYSICIANS, at 5.—Dr. E. G. Browne: The Origins and Development of Arabian Medicine: II. Four Great Medical Writers of Persia (IX.-XI. Cent.). (FitzPatrick Lecture.)

ROYAL SOCIETY OF MEDICINE (Clinical Section), at 5.—H. Curtis: Three Cases of Malignant Disease of the Face illustrating Modern Methods of Radical Operation.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Roger T. Smith: Presidential Inaugural Address.

OPTICAL SOCIETY, at 7.30.—Miss L. M. Gillman: The Chromatic Variation of Spherical Aberration in Cemented Doublets.—Instructor-Commander T. Y. Baker: The Correction of First Order Astigmatism of a Single Lens used with a Stop.

ROYAL SOCIETY OF MEDICINE (Neurology Section), at 8.30.—P. Sargent: Lessons of the War applied to Spinal Surgery.

FRIDAY, NOVEMBER 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—W. S. Franks: Micrometrical Measures of Double Stars, List VII.—F. Strömgren: A New Class of Periodic Solutions in the General Problem of Three Bodies.—J. Evershed: (1) Is Venus Cloud-covered? (2) The Solar Prominence of 1919, May 29.—J. Halm: Statistical Investigation of the Distribution of the Stars and their Magnitudes.—H. H. Turner and Mary A. Blagg: The Long-period Variable W Cygni.—N. Liapin: A Method of Determining the Mean Accidental Variation in Daily Rate of a Number of Chronometers.—H. Bell: A Proposal to Construct New Tables for Finding Position-lines at Sea.—The following Paper is promised:—Royal Observatory, Greenwich: Corona and Prominences at the Eclipse of 1919 May 29.

PHYSICAL SOCIETY, at 5.—S. Butterworth: The Self-Inductance of Single Layer Flat Coils.—Dr. N. W. McLachlan: An Experimental Method of Determining the Primary Current at Break in a Magneto.—F. W. Newman: Note on a Modified Form of Wehnelt's Interrupter. (With Demonstration.)

MALACOLOGICAL SOCIETY OF LONDON (at the Linnean Society), at 6.—G. C. Robson: Studies in British Hydrobiidæ, Part I.—H. C. Fulton: Description of a New Sub-species of *Papuina tayloriana*, Ad. & Rve.—J. E. Cooper: Additions to a List of Recent Middlesex Mollusca.

SATURDAY, NOVEMBER 15.

PHYSIOLOGICAL SOCIETY (at London School of Medicine for Women), at 4.30.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) (at Chartered Institute of Patent Agents), at 7.—W. E. Warrilow and others: Discussion on Engineering Advertising.

SURVEYORS' INSTITUTION (Junior Meeting), at 7.

MONDAY, NOVEMBER 17.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—W. R. Davidge: The Problems of London Housing.

ROYAL GEOGRAPHICAL SOCIETY (at the Æolian Hall), at 8.30.—Sir Alfred Sharpe: A Recent Journey in Liberia.

TUESDAY, NOVEMBER 18.

ROYAL HORTICULTURAL SOCIETY (at Vincent Square, S.W. 1), at 3.—C. H. Senn: Potato Possibilities.

ROYAL SOCIETY OF MEDICINE. General Meeting of Fellows, at 5.

ROYAL STATISTICAL SOCIETY, at 5.15.—E. H. Godfrey: Fifty Years of Canadian Progress, 1867–1917.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—M. F. Wilson: Admiralty Harbour, Dover.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—Rear-Admiral (Retd.) P. Dumas: The Conservation of Oil.

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—Sir Edmund Giles Loder, Bt.: Exhibition of the Skull of a Beaver.—Major J. S. Hamilton: Field-Notes on some Mammals in the Bahr el Gebel, Southern Sudan.—Dr. J. F. Gemmill: (1) The Development of the Mesenteries in *Urticina crassicornis* (Actinozoa). (2) The Leptomedusan *Melicertidium octocostatum*.—M. Turner: The Nematode Parasites of a Chapman's Zebra.—Rev. A. H. Cooke: The Radula of the Mitridæ.—Lt.-Col. S. Monckton Copeman: Experiments on Sex Determination.—Dr. C. F. Sonntag: The Variations in the Digastric Muscle of the Rhesus Macaque and the Common Macaque.—E. S. Russell: Note on the Righting Reaction in *Astropecten gibbosa*, Penn.

WEDNESDAY, NOVEMBER 19.

ROYAL UNITED SERVICE INSTITUTION, at 3.—D. Ogg: German Naval Propaganda.

ROYAL SOCIETY OF ART, at 4.30.—Sir H. Trueman Wood: Science and Industry.

ROYAL METEOROLOGICAL SOCIETY, at 5.—Lieut. C. W. B. Normand: Effect of High Temperature, Humidity, and Wind on the Human Body.—Capt. A. J. Bamford: Some Observations of the Upper Air over Palestine.—E. G. Bilham: Barometric Pressure and Underground Water Level.

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. J. E. Marr: The Pleistocene Deposits in the Neighbourhood of Cambridge.

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Sectional Meeting) (at Institution of Civil Engineers), at 6.—Prof. C. L. Fortescue: The Design of Multiple Stage Amplifiers using Three Electrode Thermionic Valves.

ROYAL MICROSCOPICAL SOCIETY, at 8.—H. M. Carleton: Note on Cajal's Formalin-silver Nitrate Impregnation Method for the Golgi Apparatus.—F. I. G. Rawlins: Report on the Collection of Metallurgical Specimens recently presented to the Society by Sir Robert Hadfield, Bart., F.R.S.

THURSDAY, NOVEMBER 20.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: W. J. Johnston': A Linear Associative Algebra suitable for Electro-magnetic Relations and the Theory of Relativity.—Sir Joseph Larmor: Note on Mr. W. J. Johnston's Calculus for Generalised Relativity.—G. E. Briarsto: The Variation with Frequency of the Conductivity and Dielectric Constant of Dielectrics for High Frequency Oscillations.—F. J. W. Whipple: Equal Parallel Cylindrical Conductors in Electrical Problems.—G. A. Schott: The Scattering of X- and Y-Rays by Rings of Electrons. A Crucial Test of the Electron Ring Theory of Atoms.

LINNEAN SOCIETY, at 5.—I. K. Patten: Plants collected in Mesopotamia and in Southern India.—C. C. Lacaita: *Orchis maculata* from Monte Gargans.—Dr. G. C. Druce: Two New British Plants.—Miss Trower: Paintings of British *Rubi*.—Prof. R. C. McLean: Sex and Soma.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—H. L. Sulman: A Contribution to the Study of Flotation.

CHEMICAL SOCIETY (and Informal Meeting), at 8.

FRIDAY, NOVEMBER 21.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—C. G. Conradi: The Present Position of Mechanical Road Traction.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Meeting) (at the City and Guilds (Engineering) College), at 7.—A. P. Trotter: Opening Address.

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